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The final plans for the reclamation of the Zuyder Zee [See page 251]

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Publisher's Dilemma

ANNOUNCEMENT was made on this page, last week, of an advance in the yearly subscription price of the SCIENTIFIC AMERICAN from $4.00 to $5.00, to take place on November 1st next. This step was taken very reluctantly after exhausting every means of meeting the trying industrial and manufacturing conditions produced by the war. We are going to take you into our confidence and explain the situation that has made this advance imperative.

There has been a marked increase in the cost of paper this year. This in itself is a serious factor, but by no means the only one affecting the subscription price. The cost of printing has risen over 30 per cent, while the cost of labor in handling the periodical has increased more than 100 per cent. We are paying 200 per cent more this year than last for the wrapping paper in which the SCIENTIFIC AMERICAN is sent to subscribers. In addition to this, there has been an advance in the cost of drawings and photoengravings. Furthermore, we are obliged to meet the new postal rates, which have imposed an additional burden amounting to several thousand dollars per year and this will increase annually for the next four years.

It is clearly evident, therefore, that, owing to the ever increasing expenses it is impossible to publish the SCIENTIFIC AMERICAN and maintain its present standard of quality without receiving a greater return from the subscriber. The expense of conducting all classes of business has increased since the war began, and the publishing business is no exception. We believe you will feel that we are justified in following a policy which we have considered for a long time, but which we find to be absolutely essential and actually unavoidable in view of the present conditions.

Germany and the French Ore Deposits

SOME two years ago the commercial men engaged in big business in Germany, and particularly the great captains in the steel industry, drew up a memorial in which they represented to the Government the absolute necessity for the retention and permanent occupation of the great iron ore deposits of Lorraine which were seized by the German armies in 1870 and in their first great rush into France in 1914.

The most extensive and valuable of these districts is a considerable section of country lying to the west and northwest of the city of Metz, partly on the German side and partly on the French side of the frontier, and known as the Briey Ore Basin. One of the first fruits of the invasion of 1914 was the occupation of the French half of the Briey Basin: and in the memorial above referred to the German steel makers laid great stress upon the fact that, so large was the proportion of the total ore supply of Germany derived from the Briey Basin, that if this district should be recaptured by the enemy, the manufacture of war materials—guns, shells, etc.—would be so greatly handicapped that it would be impossible to continue the struggle.

Before the war of 1870-71 the whole of this mine field was included within the French frontier; and when the treaty of Frankfort was drawn up, one of its most disastrous clauses for France was that which drew the new frontier right through the center of the Briey district, and robbed France of more than one-half of its mineral treasure. Not only did the sub-division make a vast addition to the German iron supply, which previously had been all too scanty for her growing needs, but also that part of it which was left to the French was so essential to the French steel industry that out of its mines the French took over seventy per cent of the total iron supply of the whole country.

A mere glance at the statistics of the steel industry shows that the capture of the French mines in this Basin and elsewhere in Luxemburg and northern France was absolutely necessary to the enemy to enable him to prosecute the war on the vast scale of the past four years.

Thus, before 1914, the German production of iron ore amounted to about 28,000,000 tons annually, and of this no less than 21,000,000 tons came from the German portion of the Briey Basin. The production in France was 22,000,000 tons, of which 15,000,000 tons was mined in her portion of the same district. Consequently, the over-running of the French mining districts deprived France, at a stroke and at the very outset of the conflict, of eighty per cent of her iron supply, with the result that it has been necessary for her to obtain her iron from England and from the United States. Germany, on the other hand, not only has been able potentially to increase her annual output by the 15,000,000 tons taken from France, but also from the Luxemburg mines she achieved a further potential increase of some 6,000,000 tons per annum.

Now, this matter of the Briey Ore Basin should possess a profound interest for the United States, inasmuch as the recent brilliant success of our armies in reducing the St. Mihiel salient has carried our troops some ten to fifteen miles nearer to the Briey Ore Basin as a whole, and along a stretch of two or three miles has placed our armies in actual contact with it. About five miles to the east of the basin and a dozen miles from the American front lines lies Metz, forming, with its concentric ring of modern fortifications, one of the strongest fortified cities in the world.

The capture of Metz, entailing an advance of our front no greater than that which we achieved in wiping out the St. Mihiel salient, would place this invaluable ore basin within our grasp. Not only would France thereby be restored to the favorable position in respect of her iron supplies that she held in 1914, but also the whole steel situation as between France and Germany would be reversed. For with the capture of the German portion of this basin, not alone would France and Italy be provided with super-abundant supplies of the raw materials for steel, but the German steel industry would within a few weeks' time find itself absolutely crippled. Nor is that all; for the Briey Basin is almost as rich in coal as in iron, and the recapture of the basin and of the coal fields in the Lens district, would completely relieve the distressing coal shortage in France.

Although these facts prove how valuable is the prize which is now within reach of General Pershing's army, we must not fall into the error of believing that its capture will be an easy task. On the contrary, because of its absolutely vital significance, and because its loss, entailing an enormous reduction in the output of German war materials, would mean a speedy collapse of the whole German cause, we may be certain that Ludendorff will put up a furious and sustained defense.

The question of the recapture of Metz and the Briey districts depends upon many factors, such as the condition of the defenses of Metz, the weight and range of its heavy guns, the amount of heavy, long-range artillery that we can bring to bear for its reduction, the number of divisions that Ludendorff can throw into the fight without a fatal weakening of the rest of his front, and above all, the morale of the German army.

Metz will be taken; but whether it will fall before the winter's rains and snows set in, or whether its defense can be carried through the winter and into the spring campaign, no one, not even the High Command among the Allies, can tell with certainty. But this we do know—that our victorious American army under General Pershing finds itself face to face with a task, which should it be quickly and successfully accomplished, may easily prove to be the final, decisive stroke of the war.

The Battle Against Ignorance

ONE of the most useful allies of the Germans in this great war is ignorance. It has been carefully nurtured and fostered with big doses of misinformation. With the press muzzled and the nation's boundaries tightly sealed by the censor, the military powers of Germany are well able to keep up the delusion that they are not fighting a war of aggression but of self-defense. The great mass of the Teutons still believes that the war was forced upon them by the scheming allied powers of the Entente, and that they must keep on fighting for their very existence.

This same German ally has been at work here in our own land. Although our newspapers and periodicals have been free to publish the whole truth, and are constantly telling the story of German militarism, exposing their plans for world domination, and preaching the necessity of coöperation on the part of all of us, a vast amount of ignorance persists. When we launched upon our vast shipbuilding program, we came into conflict with this ally of the Germans at the very outset. There were constant strikes among the men; the workmen were forever demanding higher pay; many were unreliable in their attention to work, frequently taking as many days off as they put in at the shipbuilding plant; they were constantly deserting one job in search of another that would bring in better wages. But this is changed now. Under the able leadership of Dr. Eaton, whose story was told in the SCIENTIFIC AMERICAN of September 7th, a campaign of education was begun among the ship workers. The men needed only to be told that their work was part of the war and upon them depended the success of our army abroad. They were not pro-German at heart; it was merely ignorance that made them, unwittingly, the allies of the Germans. When they began to feel their part in the war there was an instant response resulting in a wonderful increase in productivity.

With this example of the invaluable benefits of a campaign of education, why should we stop with the ship worker? There are other industries fully as important to the winning of the war. Among these probably the most important is that of mining coal. Upon the miner we are dependent for most of the power produced in this country, and without mechanical power our industries must come to a standstill—without mechanical power we cannot attempt to wage a modern war. It is the ship worker who builds the ships, but it is the miner who controls the steel and machinery with which they are built and who finally sends the ships across the ocean freighted with millions of men and enormous stores of food and fighting materials for our army. Evidently not all of our miners realize how important a position they occupy in this war, otherwise we should not have had a serious strike at this critical time in the anthracite regions of Pennsylvania.

Let us by all means have a central bureau of education from which men can be sent out to address the workers, not only in the shipbuilding plants, but in other branches of industry, and above all among the men who are mining our fuel.

Trade-marks in South America

AN American soap-maker built up in Panama quite a trade in a brand of soap bearing his mark of a cock, duly registered in the United States. But he omitted to register this mark in Panama; so an observant resident of the isthmian republic attended to this detail for him. The result was that the American had to stop doing business in Panama until he had purchased back, from the exponent of squatter sovereignty, the rights to his own mark. He had in the bargain a narrow escape from seizures and fines as a penalty for his "infringement."

A similar experience befell one of our leading automobile manufacturers in Argentina; a second company, refusing to be blackmailed, is today barred from selling its trucks and cars in that country. Other American companies have paid as high as $50,000 to redeem their marks from the clutches of fraudulent resident registrants.

All this is made possible by the peculiar provisions of the Latin-American trade-mark laws. The United States requires that a trade-mark be actually used by the applicant before it can be registered in his name. A single sale in interstate commerce of a single article is sufficient to meet this demand, but such a sale, involving actual use of the mark, is essential. But throughout South America marks are registered in the name of any first applicant, without inquiry as to prior use by him or anybody else; even subsequent use is not required.

We will not presume to say that this provision has been tolerated in these countries with the deliberate intention of favoring residents at the expense of outsiders; but this is of course its effect. Natives, and especially German residents, have made a regular business of watching for successful new American goods, and appropriating the marks if the owners neglected to register them. Cases of such omission are, in fact, frequent; a man who has no present intent of going into the export trade may well have trouble in seeing why he should spend good money protecting his marks in an assorted lot of foreign markets.

The victims of this piracy have usually protested to the State Department, apparently with the idea that our southern neighbors should be cajoled or bullied into changing their laws. But if a South American exporter demanded that we revise our laws to conform with his ways of doing business, we should be—well, let us say, amused. It has always seemed to the SCIENTIFIC AMERICAN that the cost of protection through registration was really trivial for one who had a mark of value, and that the correct course for American merchants to follow was to register their marks in Latin America and hope for a day when Latin legislators would realize the wrong principle on which their law was based.

The State Department has at length succeeded in arranging, with most of the Governments concerned, a treaty which protects our trade-marks in South American markets for a period of six months after their registration here. We would point out that this does not relieve the American manufacturer of the necessity of registering abroad, sooner or later; and we would urge him to do it sooner rather than later. Even after the new treaties go into force, there is no reason why American manufatturers cannot file their marks in South American countries at the time of filing here. This is the simplest and most logical procedure; and when it is adopted, the thing is settled and out of the way.

Electricity

Separators for Storage Cells.—A French patent taken out by Mr. T. A. Villard, describes a form of separator for accumulators or storage cells. This appears to consist of two ingredients, *i. e.*, a porous material, such as a cheap textile, and a non-porous pliable substance such as rubber. The layers of the materials are compressed and vulcanized. Horsehair, cotton or wool fiber is suggested for the textile substance, while celluloid may take the place of rubber.

Wireless and Air Mail Pilots.—The air mail pilot is solving the problem of flying in all sorts of weather. Prior to the establishment of the Air Mail service it was regarded as impracticable to make flights with airplanes during severe storms. On August 1st Lieut. Bonsal, flying from Philadelphia to Washington, ran into a violent thunderstorm at Laurel, Md., at an altitude of 5,000 feet and proceeded on his way to the landing field in Washington without interruption. It was impossible to distinguish any landmarks in such torrents of rain. When he descended to a lower level for observation he was near the wireless towers at Radio, Va. To observers he appeared to drop out of the clouds from nowhere at an angle of 45 degrees to a height of about 300 feet when he leveled the plane and made a perfect landing at Potomac Park in the midst of a torrent of rain. The plane arrived on schedule time, not being delayed by the storm. The propeller was slightly damaged by the pelting rain. Lieutenant Bonsal was not assisted by radio guide but depended entirely upon his compass and his judgment from familiarity with the route. When radio and other systems for determining location, which are being tried out, are installed it will greatly simplify flights of this sort, the *Wireless Age* remarks.

Vibration of a Stretched Wire in Electric Circuit.—Some interesting experiments on this subject were described by Admiral Sir Henry Jackson at a recent meeting of the Royal Society. A large thermo-microphone consisting of a long loop of wire warmed by an electric current, subjected to vibration produced by sound waves, continued to respond to the effect of the vibration in suitable receiving apparatus after the electric battery had been cut out of its circuit, and when the wire was at the same temperature as the air. This result of the wire's vibration could not therefore be solely attributed to the wire's being maintained at a different temperature to that of the surrounding air by an electric current in it. Varying the angle of the wire with line of the earth's magnetic force produced entirely negative results. Wires of various materials and of lengths up to 220 feet (the longest tested), stretched and subjected to forced vibrations, almost invariably generate a current of electricity in the circuit of sufficient intensity to be audible in a suitable telephonic receiver, with or without an added E. M. F. in the circuit. The addition of a valve amplifier, continues *The Electrician*, greatly increases the intensity of the sound. Resonance plays an important part. No conclusion can yet be drawn as to the quantitative effect of altering tension or length of wires, or their displacement, on current generated; the energy expended in producting vibration is not proportional to the effect produced unless resonance is present.

Electric Welding in the Building of Ships.—Prof. Comfort A. Adams, chairman of the American Institute of Electrical Engineers, has appointed a special committee to investigate the possibilities of electric welding in shipbuilding. This committee includes representatives from the manufacturers of welding machinery, the classification societies (Lloyd's and the American Bureau of Shipbuilding), the Bureau of Standards, the Navy Department and shipbuilders. As a result of their investigations, the members of the committee became convinced that time and material could be saved by the introduction of electric welding methods. The committee was reorganized and assigned a definite work by the Emergency Fleet Corporation. An office has been established in room 716, Engineering Societies Building, New York city. The Emergency Fleet Corporation has authorized the construction of a 50-foot section of a 9,600-ton standard ship at the yards of the Federal Shipbuilding Company, Newark, N. J., for the demonstration, development, and application of electric welding to an actual ship structure. The construction of this 50-foot section will be under the direction of Arthur J. Mason, of the Fleet Corporation, who has been active in advancing the use of electric welding for shipbuilding. The particular ship section is to be sealed up at the ends, filled with water, and tested by hydrostatic pressure. Both spark and arc welding are to be employed. The foundation of this structure is already complete, and the work will be pushed as rapidly as possible. Large stationary and portable spot welders are being designed for this work, and various arc-welding systems are being studied. An installation will be made in the Hog Island yard at Philadelphia. The committee is responsible to Daniel H. Cox, manager of steel ship construction of the Emergency Fleet Corporation, who is lending every possible aid to its work.

Science

Chemical Scholarships.—One of the big industrial chemical concerns which has been driven, by the necessity for utilizing waste and by-products, to enlarge its business from powder and dyes to pretty much everything under the sun, has done its bit toward the promotion of chemical engineering by the endowment of 18 fellowships and 33 scholarships in chemistry at various universities. This action has been brought about by the growing importance of the chemist in the world's industry and by the difficulty experienced in obtaining adequately trained men.

The Lightest Known Wood.—A consular report from Port Limon, Costa Rica, gives interesting details concerning the trade of that region in balsa or corkwood (Ochroma), said to be the lightest of all known woods. It has long been used in tropical America for making canoes and a special type of raft, also known as a balsa. It is very porous and a good insulator against heat and cold, and the report above mentioned states that it would be valuable for airplane construction. The young trees are soft and very sensitive to injury from vines. The trees are dicœcious, the male tree being known as burillo and the female as balsa real. The shipment of balsa wood has apparently not assumed large proportions, owing to the difficulty of transporting it from its native forests to the railway.

The Errors Which Affect the Definition of a Lens are discussed in a recent publication of the Bureau of Standards, and methods are described of representing graphically the central errors. The relative importance of the errors in the different types of lenses is brought out. Hartmann's method is extended, permitting one set of measurements to give all the important central errors—spherical aberration, zonal variation of the equivalent focal length, axial and oblique achromatism. The apparatus and procedure are set forth fully, and the accuracy of the adjustments and results discussed. The method is applicable to all systems of relatively short focus and large aperture, such as photographic lenses, projection lenses and telescope objectives, as well as to complete optical systems. The discussion forms a part of the Bulletin of the Bureau, Vol. 14, No. 3, and will be sent to any address by the Bureau for 25 cents.

Metallic Properties of Zinc Sulfide.—Recent experiments of the Bureau of Standards have shown that zinc sulfide may be prepared in the form of short wires or strips, like a metal, and that when thus prepared it has many of the properties of a metal. The wire, which must be drawn hot, is found to conduct electricity like a metal of high specific resistance and practically zero temperature coefficient. The strips, rolled at room temperature, have a large temperature coefficient, and show both metallic and electrolytic conduction at the same time. The resistance of these strips has been examined with both alternating and direct current, and has nearly always been found higher in the former case than in the latter. The passage of a small alternating current of a frequency as low as sixty cycles increased temporarily the resistance of the sulfide, while a small direct current produced the opposite effect.

Plants in Unventilated Chambers.—Whether plants, like animals, need ventilation when growing indoors is a question concerning which there has been some discussion. A series of experiments carried out by F. C. Newcombe and Etta A. Bowerman, of the University of Michigan, lead to the following conclusions: No ill effects manifested themselves as due to confining plants in stagnant air in small or large chambers. The greatest objection to small chambers, as bell jars, comes from the growth of injurious fungi on the plants, owing to the excessive moisture. With few exceptions the cultures showed that in small chambers seedlings grow taller, produce larger and more numerous leaves, and become exhausted so that they fall over a day or two earlier than in a larger ventilated chamber. Not only is ventilation of no effect in producing better seedlings in a small or large chamber in the dark, but it has no visible effect on the sensitive reactions of geotropism and heliotropism.

Specific Heat of Saturated Ammonia.—Using a calorimeter of the aneroid type specially designed for the peculiar conditions, the specific heat of saturated liquid ammonia has been determined throughout the temperature interval 45 degrees to −45 degrees Centigrade. Two distinct and independent methods were used, each of which avoided sources of error present in the other. In the one a fixed amount of ammonia is heated, and the corrections applied for the vaporization. In the other the calorimeter is kept full of the liquid at a constant pressure, and a correction for the heat withdrawn in the expelled liquid is determined by special experiments. The greatest difference between the mean results of both methods and the results of either method as represented by empirical equations is less than one-tenth of one per cent. As a final result an equation is set up representing the specific heat, in joules per gram per degree Centigrade, throughout the interval under consideration, as a function of the temperature, in degrees.

Aeronautics

Enemy Cities and Allied Bombers.—From an Austrian source information has been received in Rome, that the people of Vienna and Berlin are beginning to entertain serious fears of enemy air raids on their cities. A Vienna paper speaks of the growing frequency and extent of the Entente aerial operations over both German and Austrian towns. The paper speaks with alarm of the growing superiority of the Entente aviation, and admits that all the Allied powers now possess machines powerful enough to enable them to make bombing raids on the German and Austrian capitals.

Stability and British Machines.—Of late the British airplane designers appear possessed with the idea of making their planes more or less self stabilizing. For instance, the little S. E. 5 single-seater scout is an excellent machine as far as speed and climbing ability are concerned; but because of the pronounced dihedral of its planes and the consequent self-stabilizing effect, it cannot maneuver as rapidly as other machines. And after all, a chasse machine is one that should be extremely flexible in flight, for extreme mobility is as valuable a factor as either great climbing rate or great speed.

New German Aircraft Mark.—From a German source the *Nieuwe Rotterdamsche Courant* learns that a change has been made in the markings on German machines. The arms of the black cross are now straight—and not curved—with white edges. The change is said to have been made because the previous form made recognition of German machines very difficult, and because it easily led to confusion with the circular signs on hostile machines. We might add that this is perhaps the reason why the Germans themselves so often make the error of marking their airplanes with Allied marks; it is so easy to confuse them!

A Workman's Error.—In order to discourage and even punish careless work on aircraft, the following case might well be applied to others: At Tottentham Police Court on August 1st, William Benjamin Smith, of Tottenham, and James Harding, of Enfield (both in England), were summoned by the Ministry of Munitions for committing certain acts likely to endanger any person using an airplane. They were also summoned for doing certain acts calculated to deceive their employers as to the quality of certain material. It was stated that the men were working on spars for Handley-Page machines, and Harding held a square while Smith drilled a hole in an airplane spar. The hole was a quarter of an inch out, and after discovering their error the defendants stuffed the hole with a plug, and made another hole in the right place. The effect was to reduce the strength of the spar. A government inspector who detected the mistake asked Smith if he would like to ride on a flying machine containing such a spar, and Smith replied that he would not. Mr. Rowland Chessum, the proprietor of the factory, said he had repeatedly impressed on his workers the need of exactitude. When he was informed of the incident he called the work people together and again reminded them of the importance of their work. He also dismissed Smith and Harding. The defendants were fined. Now the moral of this story is that the workmen in aircraft factories hold the life of many airmen in their hands, and under no circumstances should they allow faulty work to pass on. If they do, then they are guilty of a very serious crime.

New British Bombers.—It is stated, says the *Daily Chronicle*, that the Royal Air Force will soon have swarms of a new type of machine at the battlefront which is likely to add greatly to the difficulties of the Germans. This machine, a brilliant example of the constructor's art, is capable of carrying with its pilot and observer a great weight of bombs, machine guns, and other equipment, to over 20,000 feet, and in an extraordinarily short time. Soaring, as the new machine will, above the average range of guns and German airmen, it can cross the fighting lines, drop its bombs, and return home swiftly for a new load. So fast is it, even at great altitudes, that long distances can be accomplished in the shortest periods, and bombing raids which with the older type of machine would, perhaps, need a whole day's preparation, will now be carried out within a couple of hours. Moreover, what is of the utmost importance, their engines are completely reliable, and the risk that they might fail when a hundred miles over the enemy lines—a risk too common with some of the earlier types—no longer exists. It says much for their supreme value that, so far, not one of this type has been brought down, in spite of the Huns' utmost efforts. When the weather will not permit high flying, as is often the case in the winter, these machines will fly low, and so great is their speed that all but the very fastest of modern scouting planes will be left behind them. For these machines the utmost skill and nerve are needed. The observer must not only be able to ward off hostile craft by accurate machine gun fire, but he must also have an expert knowledge of map reading and aerial navigation, since when flying long distances at great heights it is extremely difficult to find one's way by any landmark.

Woods for Making Airplanes

The Requirements of the Various Parts, and the Species with Which They Are Met

By Samuel J. Record, Professor of Forest Products, Yale University

Oxen entering the surf with a squared log of Central American mahogany

THE principal reason why airplanes are built so largely of wood is that this material combines strength and stiffness and resistance to impact with lightness in weight. Wood is composed of cells, minute hollow fibers and tubes, all intimately joined into a structure designed to give the massive leafy crown its place in the sun and to carry to it the water supplied by the roots. The hollow fibrous cells with their firm but yielding walls provide at once the requisite strength for support and the necessary channels for the flow of sap.

Since the substance composing the walls of the wood cells is of a colloidal nature, wood will not crystallize under vibration as metals do. On the other hand, this property of wood substance gives it an affinity for moisture and is the source of much of the trouble attending its use. Like parchment, it stiffens and hardens upon drying, losing pliancy and plasticity and becoming more brittle. Moreover, wood has the ability to absorb moisture from the air; so unless tightly sealed with some impervious coating, it will respond to changes in the humidity of the atmosphere by varying its size and often also its shape. For most uses wood must have a large proportion of its moisture content removed and if this is done improperly the whole cellular structure is in danger of collapse.

While all woods have certain properties in common, yet in their physical characters they exhibit the widest range imaginable. Some of them, for example, are lighter than cork while others are so heavy that even when dry they will sink in water like a stone, and are so hard that they strike fire from the ax. Composing the forests of the world are literally thousands of different species of trees, no two with woods exactly alike. The opportunities for selection for any special purpose would appear to be unlimited.

Whenever wood is to be used in quantity one of the prime essentials, of course, is the matter of available supply. It is not unlikely that every wood in the world is better suited for some particular purpose than any other wood is; yet if the cost of getting it is prohibitive or the supply insufficient some substitute must be found to take its place. The number of woods suitable for a given purpose decreases in geometric ratio with the exactness of the requirements. In the building of a house almost any tree growth can be made to serve, but for the construction of an airplane the forests of the world yield only three woods of first choice. These three are spruce, ash and mahogany, each with its own sphere of usefulness.

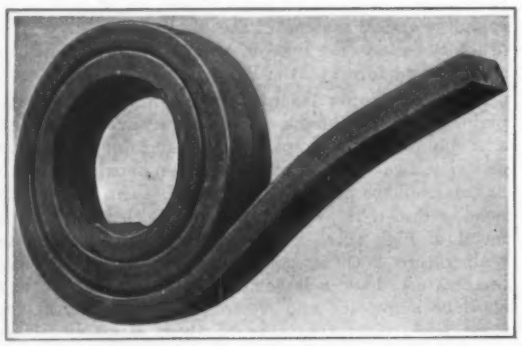
Of all the woods, spruce has proved to be the stiffest, strongest, and most resistant to shock for its weight. Consequently it is first choice for the structural components, except where a much harder material is demanded to meet special needs. It is interesting to note that spruce has not previously ranked very high except for two purposes—the manufacture of paper pulp and the making of sounding boards for musical instruments. In the building trade it has been characterized as a "cheap" wood.

There areseveral species of spruce, but the one supplying the bulk of the airplane timber is the Sitka. This is one of our largest timber trees and reaches its greatest development along Puget Sound. For the most part it is confined to a narrow coastal belt, occurs in patches, and is usually in the minority in a stand of Douglas fir, hemlock and cedar. The Government has fairly accurate data compiled from all possible sources showing the approximate amount and location of this timber. It is estimated that of a total stand of some 12 billion board feet about one-third is accessible, but not more than 200, or at the most 300, million feet would be suitable for airplane purposes.

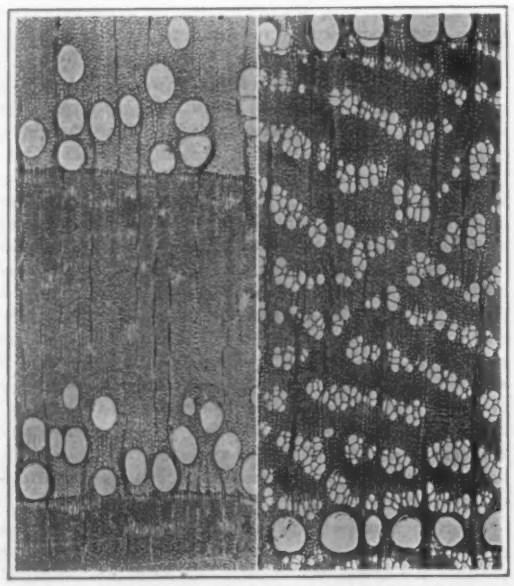
There is spruce enough in the forest, but the difficulties of getting it immediately in sufficient quantity to meet the demands, not only our own, but also of our Allies, have not yet been entirely overcome. What these difficulties are has already been outlined in these columns. The temporary shortage of spruce is accordingly compelling the use of other woods. Douglas fir, which may be had in any quantity and sizes desired, is one of these. It averages much heavier than spruce and, while correspondingly stronger in most ways, is scarcely an equal in shock resistance. There are various objections to its use; but carefully selected material is better than some of the grades of spruce now available.

Eastern white pine is of about the same weight as spruce and will hold up about the same loads. It is not so stiff and resilient, and is also softer, giving some trouble in fastening securely at the clips. The other pines are either too hard and heavy or too soft and weak to be used except for some of the less exacting parts. Southern cypress has been tried but seems to be lacking in stiffness and is often cross-grained and inclined to warp. Port Orford cedar or Lawson's cypress of the Pacific Coast provides a very good substitute for spruce and has been in use by the Allies for some time. The supply, however, is decidedly limited.

About the only hardwood or broadleaf species giving promise of success as a substitute for spruce is the yellow poplar or tulip tree of the Middle West and the Southern Appalachians. The best grades are light and strong and mostly straight-grained, though here and there



A piece of white ash 2 x 6 inches, coiled up tightly to show adaptability of this wood for bending



White ash (left) and elm (right) cuts, under a magnification of 25 diameters, showing characteristic structures

patches of irregular grain exert a warping influence. Yellow poplar is one of the very best core woods upon which to glue veneers of birch, mahogany or black walnut to supply ply-wood for various parts of the framework.

There are certain parts of an airplane where the demands on the strength of spruce would be too great for the wood to stand. In such places light weight has to become a secondary consideration. Examples are tails and wing skids, tail post, wing tips, the front of the fuselage where the weight of the motor makes extra shock in landing, and sometimes in the fuselage longerons. For certain of these purposes the wood has to be steamed and bent to form. The best material for this purpose is second-growth white ash. It is strong, tough, resilient, straight-grained and the best of all woods for bent work.

There are several different species of ash growing in the forest, but when they emerge from the mill they have all become white ash except one which is known as black or brown ash. This transformation sounds rather remarkable when it is realized that the different species bear such colorful names as red, blue, and green ash. The lumber, however, of all except the black is so nearly alike that selection should be made on a basis of quality as indicated by the density rather than with respect to botanical differences.

By "second-growth" is meant wood which has grown rapidly and has therefore wide rings, such as one finds in young thrifty timber with plenty of room for development. Ash trees in a dense forest are forced to grow more slowly and the wood is lacking in density. Trees growing in sloughs and wet lowlands usually produce material that is brashy and light compared with that grown on uplands. The swollen bases of some of the trees in the Mississippi bottoms produce wood that is extremely light, soft and punky, although on drier land the butt log affords the best grade of timber. There was formerly a prejudice in favor of the white wood or sapwood as against the dark-colored heart; but tests have shown that, other things being equal, there is little if any basis for discrimination in the matter of strength.

There are two substitutes for ash. Hickory is even more resilient and tough, but it is harder to season without splitting, is not so well adapted for bent work, and besides is badly needed for other purposes such as the spokes and rims of artillery wheels and for tool handles. Elm is coming into more extensive use as substitute for ash in airplanes. Owing to the peculiar laminated structure of its bands of fibers and pores it is very tough and pliable. In the steaming and bending process it does not behave as well as ash but has a decided tendency to warp and buckle, thus requiring more care with the forms.

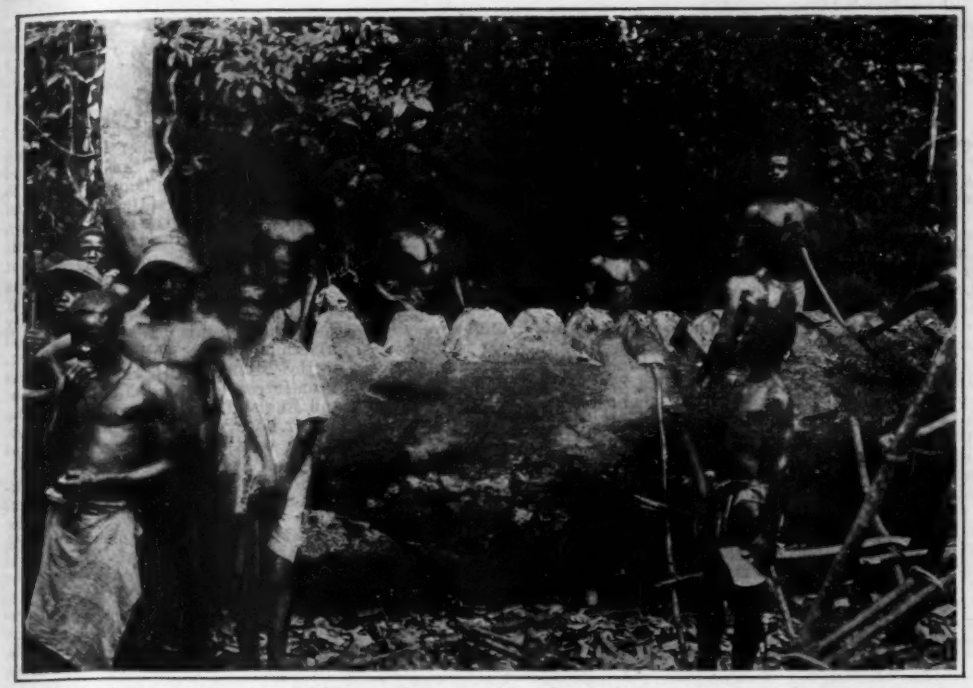
There are three common species of elm in the North and two of much less importance in the South. The rock or hickory elm is usually the densest and the straightest-grained and is accordingly most desired. The white and slippery elm are mostly of lighter weight and of poorer quality but some specimens are as good as the rock elm. White elm is of more irregular growth and more inclined to warp than the slippery kind. Choice should be made on a basis of the density or weight of the dry wood rather than on species, though the rock elm will give the highest percentage of good material. Unlike the ash, there seems to be no definite relation between the width of rings and the strength of the material except in the case of overmature timber, which is of very slow growth and weak. Elm averages heavier than ash, but weight for weight it is weaker except in shock resistance. Here it exceeds ash considerably, due to the extreme tenacity of its bands of fibers.

The foregoing has been confined to considerations of the airplane frame. The propeller must be considered separately. The requirements of a good propeller wood are strength, good cabinet qualities, moderate hardness, ability to glue up well in the laminations, freedom from warping, absence of distinct planes of cleavage, and reduced tendency to shatter when pierced by bullets.

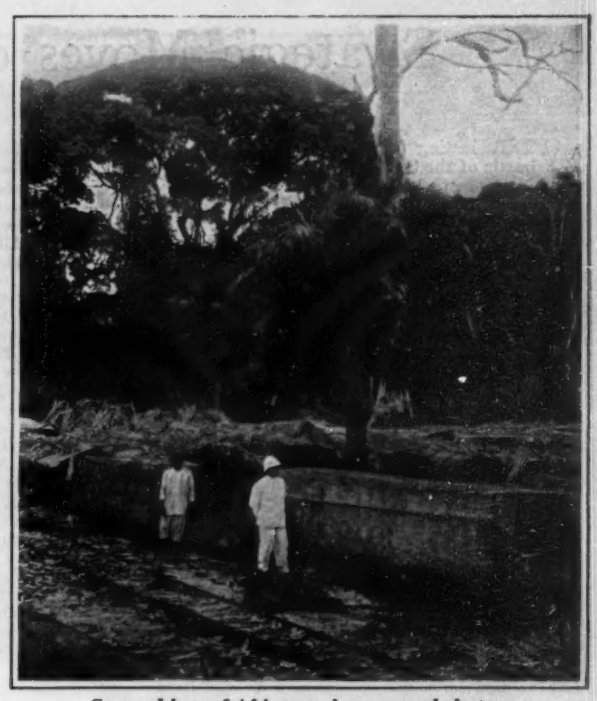
There are two main classes of propellers depending upon their use for training planes or combat machines. The former are smaller, for use with motors of comparatively low horse-power. Run at correspondingly low speed, they are not so exacting in the woods used. The combat type is used with motors of great power, operated at terrific speed and given the most severe field service, necessitating the greatest care and discrimination in the materials used. Few species are considered equal to the requirements.

For the combat type of propellers the woods now used are the true mahogany from tropical America and its close relation from Africa, and two native woods, namely, white oak (quarter-sawn) and black walnut. For the training propellers the list is extended to include the so-called Philippine mahogany, black cherry, yellow and black birch, and sometimes yellow poplar, especially for the "penguins."

The genuine mahogany of tropical America is produced by two or more species of *Swietenia*, and most of that now being used comes from Central America. The bulk of the existing supply is in southern Mexico, but the unsettled conditions there are retarding its exploitation. The material from the northern part of South America is mostly of a rather inferior quality and is also likely to be mixed with spurious goods. The supply from the



Natives squaring a log of African mahogany. After the notches are cut, the projections are knocked off and the faces smoothed



Squared logs of African mahogany yarded at a railroad spur

West Indies is limited and most of it is of the harder, furniture grades. Mahogany exhibits a very wide range in quality and appearance, varying in specific gravity from .28 to .75, and from very hard and brittle to as light and soft as some of the medium grades of Spanish cedar. In fact some of the grades of the cedar are almost impossible to distinguish from mahogany and probably enter more or less into the supply. The grade of mahogany being used for propellers has a specific gravity between .45 and .55 and is fairly straight-grained. The white mahogany or prima vera from the same region is being tried out. It is not a mahogany at all but belongs to the same family as our native catalpa.

The African mahogany (*Khaye senegalensis*) comes from the west coast tributary to the Gulf of Guinea. The tree is of splendid timber form and one of the most valuable on the continent. It is felled by native labor, squared with axes, dragged to the logging railroads and hauled to the wharves. In squaring the big logs, the blacks stand on short ladders along both sides and cut notches at close intervals to a depth indicated by chalk lines. The wood between the notches is then split off, the surface smoothed down, and the log turned for the next face. To protect the squared logs in the yards from the intense heat of the sun it is customary to cover them with palm leaves.

The African mahogany is as acceptable for propellers as the Central American wood and seems to run more uniform in quality. The specific gravity of the dry wood is about .50. It also has excellent cabinet qualities, is quite strong, does not split very readily, and when properly seasoned retains its shape exceptionally well.

From the Philippines comes several woods which are marketed under the name of mahogany and to which they have no title by lineage. They are Dipterocarps, mostly of the genus *Shorea*, and the wood produced by any one species varies about as widely as between the various species. Here again, the separation of the woods into grades according to quality without reference to botanical distinctions seems the only solution at present. The lighter, softer and weaker material, not admissible in any propellers, is commonly classed as red lauan, though as a matter of fact some of the red lauan is of a very much better sort. The better grades are variously known as tanguile, tanguile mahogany, and Bataan mahogany, and are used in the training type of propellers. In the form of very thin lumber the Phillppine mahogany is also used to some extent for planking the hulls of flying boats along with genuine mahogany and Spanish cedar.

Quartered white oak makes a very strong propeller but is quite heavy. Unless the wood is quarter-sawn, that is, cut so that the faces of

(Continued on page 261)

A New Departure in Rudders

THAT the control of boats has been sadly neglected these many years is evidenced by the new rudder invented by H. O. Westendarp, of Boston, and recently tested out on a 25-foot motorboat belonging to W. B. Landreth, deputy state engineer of New York. The tests were made on the Barge Canal near Schenectady and, equipped with the new rudder, the Landreth boat turned to the sharpest angles, spun in circles, turned in its own length, and backed at various speeds with the engine running full speed ahead. With this rudder the boat can be maneuvered without steerage way.

This test rudder on the Landreth boat consisted of two steel plates, $\frac{1}{4}$ of an inch thick, each plate the same size as the normal rudder used on this type of boat. The rudder post consists of a steel rod, inside a steel tube, and one plate, or blade, of the rudder is attached to the tube and the other to the rod. The boat is equipped with a double steering wheel, one wheel to operate the rudder affixed to the tube and the other the rudder fastened to the rod. Above the rudders is a flat steel fin or vane. The manner in which the rudders, etc., are affixed to the stern of the boat is best seen in our cut showing the two rudders close together in the position for normal cruising, when they are used in the same way as an ordinary rudder to keep the boat on its course.

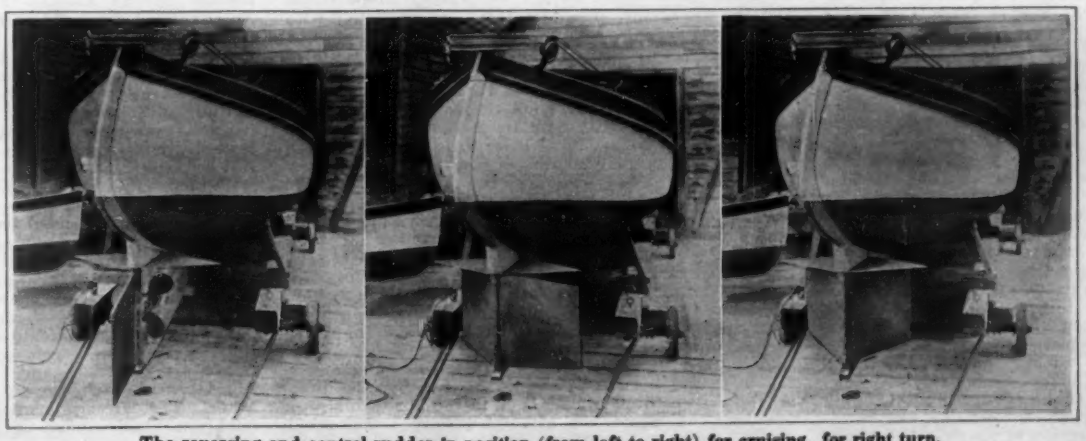
The double steering wheel is locked together to operate as one wheel for ordinary cruising. The boat is then steered normally from the wheel. But when the boat is to be turned sharply, or reversed, the wheels are instantly released so that they may be revolved in opposite directions to manipulate the rudder plates. In steering slowly to the right, or left, the rudder operates as on any other boat; but for a short turn the rudder plates are moved by the wheels to the position shown in our second picture.

It is truly remarkable how easily the boat can be made to turn within its own length while going full speed ahead. By placing the rudders in the position indicated the boat can be made to turn around in a few seconds and travel back up its own wake. How easily this maneuver is executed is proven by the remarkable photograph which gives three exposures on one plate, depicting the Landreth motorboat turning in approximately its own length while traveling full speed ahead. The exposures were made a few seconds apart and the boat made a complete turn in approximately twenty seconds.

But the most remarkable feature of this new rudder is the ease with which the boat can be reversed without stopping the engine or using reversing gears. With a few turns of the wheels the rudder plates are set in V-shape, as illustrated, and with the propeller running full speed ahead the boat almost instantly stops and sparts to run backward. The boat was brought from full speed forward to backing in nine seconds. With a reversing gear this same boat took 26 seconds to back. This reversing speed can be controlled to any degree by increasing or decreasing the angle of the plates. The reversing motion is imparted by the stream of water thrown back against the rudder by the propeller and reversed by the angle of the rudder to be projected along the sides of the boat toward the bow. The speed of this water is sufficient to propel the boat backwards at about thirty per cent of the speed when under full headway. Just how this is accomplished is shown in the drawing. It will be noted that the steel plate, or fin, above the rudder is of service in preventing the escape of the water, thrown back by the propeller from over the top of the rudder. This fin forms a bucket, which directs the water forward along the sides of the boat.

Three exposures on one plate of a boat, equipped with the new rudder, turning in approximately its own length

Diagram showing action of water against the rudder



The reversing and control rudder in position (from left to right) for cruising, for right turn, and for backing

Wooden Shipbuilding in Australia

THE lack of shipping and the pressing need of providing cargo space for the 5,000,000 tons of wheat and the large quantities of other products awaiting shipment in Australia is causing a revival of wooden shipbuilding which was comparatively important in the days when wooden sailing ships were the dominant type of vessel. Contracts have been let by the Commonwealth Government for the construction of 12 wooden vessels of about 2,000 tons each at Sydney and six of 2,300 tons at Fremantle, West Australia, with a possibility of arranging for a considerably larger number. It is also proposed to build 20 vessels of from 500 to 2,000 tons in Tasmania.

Strategic Moves of the War, September 18th, 1918

By Our Military Expert

AFTER lasting for more than fifty days, the third battle of the Somme has finally entered upon a new phase. Since the beginning of this great war there has never been on either side such a continued series of lightning blows upon an adversary that have filled him with doubt and dismay as to the intentions of his opponent. The Germans have been driven back practically behind the entire Hindenburg line of defenses extending from Lens on the north to Vailly and the Chemindes-Dames on the south, that is from the Duele River to the Aisne. Where the next blow on this line will fall is known only to the French commander and to those in his confidence; just at present the Germans do not know whether they will be allowed to rest here after weeks of hammering or whether heavy fighting is to be their lot for some time to come.

Since the beginning of the French advance, Marshal Foch has been able to take advantage of the false positions in which the German commander had placed his forces; as a consequence the latter has paid to the full the price of his errors of strategy and tactics. Now that the Hindenburg line has been reached a new maneuver on the part of the Allied commander may be necessary; though it must be said that the famous line of defense is showing itself to be no obstacle at all at many places to the advance of a victorious adversary. The Germans have not only been unable to stop the Allied thrusts, but the French have up to the present gone through the lines on a front half way down from St. Quentin to LaFère and have cut practically all the lines of communication between the two German bases. They have taken Tergnier, the center from which the railroad coming from St. Quentin branches off to LaFère; they have crossed one of the highways between the towns and are almost up to the eastern or main highroad, after which all communications will be cut. Both St. Quentin and LaFère are about to be enveloped. Their capture would leave the Germans fighting an enemy in front and with the Oise River at their backs—a most dangerous situation.

If, under all the circumstances of the present situation, the German commander cannot hold the Allies, he must withdraw to his next line of defenses, thus shortening his front to make up for lack of man power. Much has been written of these defense lines; there are no maps that show them in detail but enough is known to point them out in a general way. Of course the first is the Hindenburg line system of field fortifications that has been built by the Germans through the forced labor of civilian and military prisoners of war; the line runs from Lens southeast through Quéant, St. Quentin, LaFère and the St. Gobain plateau to the Aisne north of Rheims. It is a most elaborate system of trenches, wire entanglements, concrete block-houses for machine guns and all manner of shelters for infantry; it is further protected by areas that can be flooded when necessary for protective purposes. At present a great part of this famous line has been penetrated by the Allied forces and has been left behind. It is more than probable that, so far as a line of defense is concerned, it will soon be an historical reminiscence.

The second line extends from the fortifications of Lille to the outworks of Metz; it runs, in general, parallel to the Hindenburg line and from ten to twenty miles behind it. At Soissons north of Rheims it turns southeast, connecting with the old front to the north of Verdun and running to Pagny on the Moselle River south of Metz. There are secondary lines branching from the main line along the Scheldt north of Cambrai, between the valleys of the Oise and the Serre, and also northeast from LaFrere along the river Suippes to the north of Rheims.

The third line extends from the Scarpe River south of Lille to the Meuse near Sédan and then southeast to the Briey basin and joining the second line at the Moselle; in the region of Vervins especially there are many secondary defense lines for the main defense. A fourth line probably now completed, is intended to furnish additional defense from the Scheldt near the frontier of Belgium to Givet on the Meuse. Before the Germans are finally driven out of France and into Belgium, it is probable that stout resistance to Allied progress will be offered as each line is reached. There can be but little doubt that henceforth Germany is condemned to a defensive war and her only hope for a long continuance of the war will be to "dig in" and to force her opponents to do likewise. The campaign has failed and only an approximate victory can be gained by holding out long enough to carry out a diplomatic attack upon the Allies.

Having lost in the west, Germany hopes to save what has fallen to her in Russia and in the Balkans. Therefore, present German strategy is plain enough. Her object is to hold up and delay the Allied advance for the remainder of the present year while good weather holds; that means, for about two months. This will enable her diplomats to point to what she now holds; if allowed to keep her ill-got gains, she will merely be given time to make preparations for another trial at arms at a later date. While everything points to her failure in her diplomacy as in her military efforts, it cannot be said that a distinct military decision has so far been reached. Her armies have met with disaster but there is no certainty that the Germans can be driven into Belgium this year although the outlook is favorable. Unless there is a decided military decision, the only question will be as to how much Germany can be allowed to hold. Unless her armies in the western frontier can be broken and defeated, all peace proposals on her part are but subterfuge to gain both time and political advantages. And the best outlook is the constant Allied reiteration of the statement that there will be no peace until the German military power is utterly defeated and cast out and until the people as a whole can have something to say in the peace counsels.

All these remarks have been strictly applicable to the western front north of Verdun; but, as a supplement to his other moves in proving that the Hindenburg and other lines are only sieves when properly approached, the French commander rapidly shifted his scene of major operations when the drives on the north began to lag. On September 12th the American forces struck on both sides of the famous St. Mihiel salient, the main attack being launched on the front to the north of Toul. Its immediate object was to squeeze out the salient extending to and beyond St. Mihiel on the Meuse. By driving north on the south side, the only railroad running from St. Mihiel to Metz was quickly cut and the Germans were placed in a pocket that cost them dearly before their main forces escaped. The great blow that the French commander had been preparing fell on the Germans between Fresnes, southeast of Verdun, and that part of the line about five miles west of Pont à Mousson; as a squeezing process it was quickly a decided success. This was the more surprising as the salient had resisted all efforts of the French to reduce it since the early days of the war in 1914.

The first day's advance on a front of 15 miles made a gain of five miles in maximum penetration which, up to the present, has been added to day by day, though the main efforts have been to arrange and consolidate the positions taken and to secure the prisoners and booty that have fallen into Allied hands. About twenty thousand prisoners, 200 guns, and a large quantity of military stores have been the practical results of the operations so far in this section. And the Germans seem unable to summon from Metz or from other parts of their lines sufficient to hold back further advances of their opponents. While St. Mihiel was the immediate objective in this drive, it is proper here to recognize its general purpose and its limitation. The attack had several objects in view—first to cut out an awkward wedge on this front that always threatened any forward movement as long as it existed; second to continue the strain on the German forces by a move in a new sector as the drive on the Hindenburg line temporarily slows down, thus continuing the offensive and placing the Germans at a disadvantage as regards preparations and the use of their reserves; third, in connection with other objects, the way is now opened for an advance on the region of Briey, the great iron ore district south of Metz on the borders of Germany, Belgium and France, which might even stop German work there.

The St. Mihiel salient, since its first occupation, has been disturbed but little; for the French could not well spare the men to attempt its capture and directly in its rear lies the great fortress of Metz barring the way to any extended direct advance into Germany. In the present moves, while the French commander's objects have been strategic in a sense, his main idea has been to beat down and wear out the German army. In their retreat to the Hindenburg lines and beyond, the Germans have reached certain strong positions where they will try to stand off their pursuers and to hold them at bay. Immediately the French Commander shifted his attacks from Flanders and his center to his right flank, for it was natural to expect that troops had been moved from this front to back up and strengthen the retreating troops to the west and north. It could also be expected that, having driven the Germans back in the north to strong positions, he would not attempt bloody assaults but would maneuver to outflank and to take in reserve the enemy's forces. As regards the advance in Briey to the north, it is evident that this could not be carried out from Verdun as long as the St. Mihiel salient on the flank was held by the Germans. But once this salient had been pinched out, such a move was most natural to expect. By an advance of twelve or fifteen miles from Verdun, the Briey region would be in the range of French guns and German exploitation of the mines would at once cease. This mining region is one of the most prolific and greatest in extent in the world, covering as it does an area of almost two hundred and twenty square miles, situated in Belgium, Luxemburg, Germany and France. During the present war practically all the iron ore used in Germany has come from this region. On the contrary, as the French fields were in German hands, France has been forced to draw her supplies from the United States and England. The importance of the region to France cannot be overestimated; it has been called "the key to the war" and has been well and properly named.

The offensive along the St. Mihiel front has its limitations and is in a way subordinate to the operations on the western front. It was intended to weaken the Flanders, Artois, and Picardy fronts, to use up the enemy's reserves, to disorganize any plans made for a successful defense there, and to hinder any preparations that might have been made to undertake an offensive. It is probably only an indirect move against Metz, one of the strongest fortresses the world has ever known, as it could have an effect only by aiming to envelop the place on its western and northern side; any serious thrust would come from the French second army around Nancy which might endeavor to encircle the fortress from the south and east as that army moved to the Rhine.

The value of the place may, however, be overestimated by the Germans; such a place does not necessarily protect armies and armies may be lost by endeavoring to hold a fortress. Witness the case of Metz itself and the fate of Bazaine's army in 1870. If it can be shown that the forts of Metz cannot withstand the heavy artillery of the Allies, then the place is a hindrance and not a help, for to defend it an army loses freedom of movement and wears out its strength. Verdun was saved not by its forts, but by the French army in its superhuman efforts. And Metz may go the same way and prove in the the end the ruin of a German army trying to hold it, paralleling Bazaine's experience in the war of 1870.

It is more than probable that already the Allied lines are being pushed forward at all points that are suitable for gun emplacements on a large scale for heavy artillery to reach Metz; the present outlook is for serious work on this front and the fortress itself is slated for troublous times.

One of the most important results of the capture of the St. Mihiel salient has been the opening up of the railroad running from Verdun through St. Mihiel, Commercy, Toul and Nancy. This road is one of the main French lines and has of course been out of service since the establishment of the salient by the Germans in 1914. In order to make up for its loss, it has been necessary for the French to make a long detour to the south, reaching Nancy through Bar-le-Duc.

Following out his usual methods, it can be expected that a new blow is being prepared by the Allied commander, though where that will be is a matter of wide speculation. In view of the superiority in strength of the Allies, simultaneous attacks might be made on the front in Flanders, around Laon where already the French are gaining commanding positions, and also by an extension of the operations along the present front across the St. Mihiel salient. The English have a firm hold astride the line between Douai and Cambrai; in the confusion of the present retreat, it may be doubtful if the Germans can organize a successful defense if they are hard pushed at Douai, Cambrai, beyond St. Quentin, or at La Fère. The British have been pounding the Germans all along the lines west of Cambrai and this may be a prelude to a thrust also. As the French drive slowly forward in the direction of Laon, they are outflanking the German positions on the Chemin-des-Dames and may cause a withdrawal, thus allowing a new movement along the Aisne River extending beyond Rheims into the Champagne region. An advance here would outflank the entire German line from Rheims to Verdun. If the American troops are moving from St. Mihiel toward Briey, their logical objective under present conditions, there will no doubt be a joint attack with the French armies holding the Verdun front.

Russia appears to be re-emerging and is moving rapidly toward driving out German influence and hostile forces. Allied, American, and Czecho-Slovak forces operating from the north, east, and south are beginning to close in on the Bolsheviki in European Russia and in Siberia. The Siberian government from its capital at Omsk has declared war on Germany and has ordered mobilization of troops. The Czecho-Slovaks and Russians have settled upon a commander and have organized a general staff composed of officers of both nationalities. The latter have apparently abandoned politics and are bending their energies to defeat their Austro-German enemies. Reports mention serious conflicts with the combined Bolsheviki, Austrians and Germans in eastern Siberia, which battles have usually ended in the defeat of the latter. The latest information indicates that the railroad from Vladivostok north to Khabarovsk on the Amur River is entirely in possession of the Allies and that the last mentioned town with all of its military stores and

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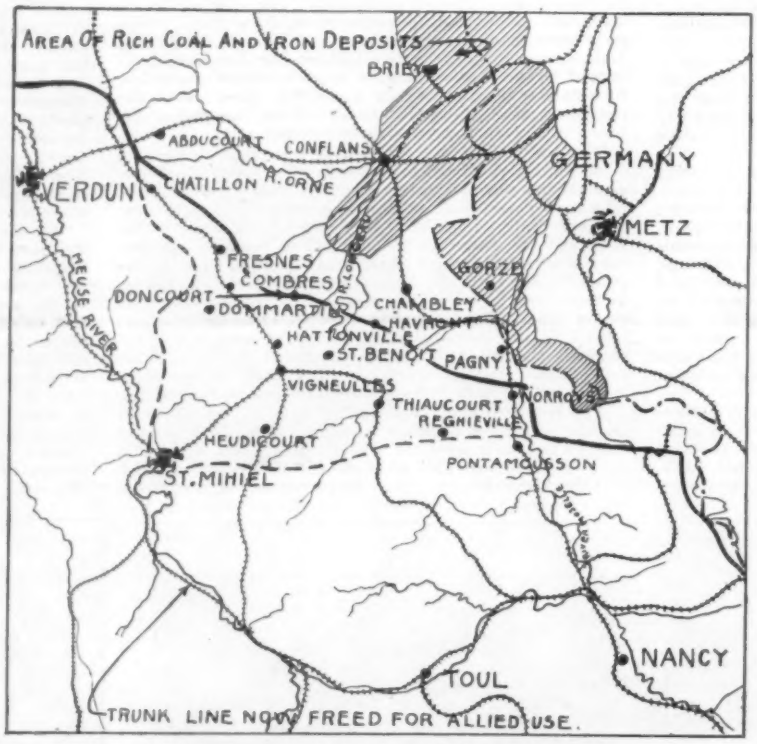
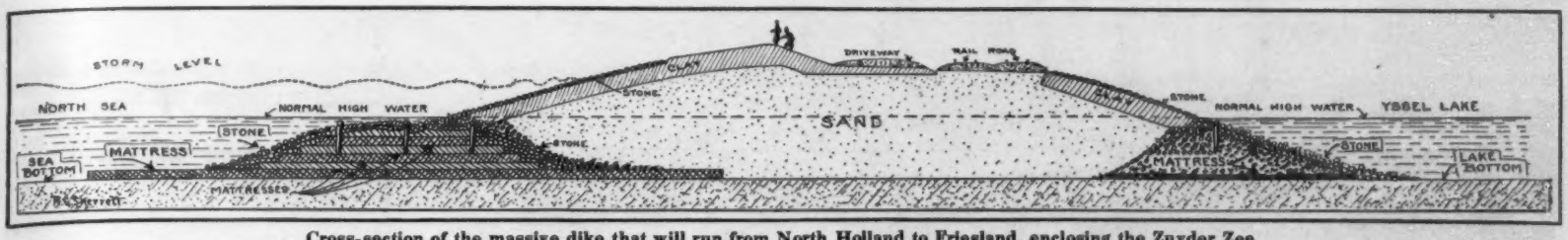


The St. Mihiel advance and the threat against the Briey iron field



Cross-section of the massive dike that will run from North Holland to Friesland, enclosing the Zuyder Zee

How Holland Will Dispose of the Zuyder Zee

A Vast Engineering Project That Will Take Thirty-three Years For Its Completion

By Robert G. Skerrett

AFTER nearly seventy years of consideration, the people of the Netherlands are about to begin the partway draining of the Zuyder Zee in order to add quite 523,440 acres to Holland's present area of dry land. For self-protection and for self-subsistence, the Dutch are today fully awake to the fact that they must have available within their midst a greater spread of fertile fields. The stress of war and the task of harboring hundreds of thousands of refugees has brought Holland to a realization of her shortage of agricultural lands. The impelling demand for food, more food, has forced upon the Netherlands the urgency of this great engineering undertaking.

After many unsuccessful attempts a bill was finally drawn up in September of 1916 which embodied broadly the essentials of a matured plan of operations, but it was not until the present year that the draft of the act was finally modified and approved by the States-General. On the 14th of June, just gone, the Queen affixed her signature and made the act a law. A commission has already been appointed to take the necessary preparatory steps looking to an early beginning of construction work, and from now on the whole project will be pushed right along according to a schedule which will cover a period of 33 years.

Before anything can be done in the way of converting the bed of the Zuyder Zee into farmlands it will be necessary effectually to cut off the North Sea in order to isolate the inland sea and make it practicable to deal with it without interference from its stormy, masterful kin. It is this phase of the work that presents the biggest engineering problems, because nothing less than a massive dike 18 miles long will suffice to shut in the Zuyder Zee and, at the same time, be sturdy enough to hold the North Sea at bay when in its angriest moods. Further, to complete the barrier, there will be reared a shorter but no less formidable bulwark across the Amstel Diep, which now flows between the Island of Wieringen and the neighboring coast of the Province of North Holland. The 18-mile section will span the Zuyder Zee in a northeasterly direction from the eastern end of the Island of Wieringen to a point on the shore of Friesland near the town of Piaam.

Through centuries of battling with both the Zuyder Zee and the North Sea, the Dutch have learned how to utilize brush, sand, and stone in rearing barriers against intrusive waters, and these will be relied upon to stiffen the defenses in the present undertaking. The first thing to be done will be the creation of an artificial island midway between Wieringen and Friesland. This will form the keystone, so to speak, of the main sea dike, and from this island, working at the same time both northeast and southwest, the dam will grow until it completely closes the gap in question.

The plan of the dike has been settled upon only after a thorough study of storm conditions and the probable seas that may have to be reckoned with. The greatest height known to have been attained by waves along the coast of the Zuyder Zee was in December of 1883, when, owing to an exceptionally severe gale, the sea level rose to a height of 7.5 feet above the prevailing water level at Amsterdam, and the surf then mounted embankments fully 17 feet above normal high tide. The height of the dike above sea level will be 17.6 feet near the North Holland end and 18.9 feet at the Friesland terminal. This difference of altitude is necessitated by the backing up of water against the coast of Friesland by reason of the currents setting in between the islands of Vlieland and Terschelling during the prevalence of northwesterly winds.

The dike will be built in two parts, and the first work will be the forming of a submerged dam rising from the seabed to the level of normal high water. This will have a maximum spread, in section, of 98 feet, and will consist of mattresses of brush, massed with sand, and topped or faced with broken stone. The main body of the dike, which will lie immediately behind and rise above the basic section, will also consist of sand on a foundation of brush and stone. It will be covered with a heavy blanket of clay, and the exposed surfaces will be protected by a basalt rip-rap. Above water, the dike will have a width of quite 230 feet and back and below the crown of the dam will be constructed a driveway for vehicular traffic and a double-track railroad. The dike proper will entail an expenditure of $11,256,000, at normal exchange.

The clay needful for the structure will be dredged from the bottom of the Zuyder Zee and dug from the island of Wieringen during the cutting of a drainage canal which will provide an outlet for the impounded waters. The need of this will be apparent when it is realized that the rivers now tributary to the Zuyder Zee will continue to flow and to discharge fresh water into the confined area. This excess will be allowed to escape into the North Sea principally by way of the canal in question, which will have a depth of 30 feet and a width of 3,500 feet. The opening to the sea will be controlled by five groups of sluiceways each of which will have six subdivisions of an individual width of 31 feet. Apart from thus limiting the use of this passage to vessels of moderate size, the Dutch Government will further guard against a hostile naval raid by the emplacement of powerful batteries on the island of Wieringen. It is estimated that the completion of the dike and certain work at the mouth of the Yssel River, which will be carried on at the same time, will take a matter of quite nine years.

In the eighth year, the building of the dike around polder No. 1 will be started, and this operation and the draining of the enclosed area will require six years. In the fifteenth year from the beginning of the sea dike the first drained section will be ready for the farmers. The Government of the Netherlands counts upon receiving annually a rental of $13 per acre for the reclaimed soil. Polder No. 2 will be taken in hand in the eleventh year and finished in the twenty-fourth; Polder

(Continued on page 261)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Where the Finicky Inspectors Come From

To the Editor of the SCIENTIFIC AMERICAN:

Your article "How Finicky Inspectors Hold Up War Work" calls to mind my attempt to secure appointment as small arms inspector. The two may afford a good example in cause and effect.

In the editorial columns of several Boston papers and, I believe, a great many other publications throughout the country, there was an appeal to those of experience to take up the work of inspection of small arms, as the Government was in great need of such men.

Forthwith I hied me to the office designated and eventually arrived at the desk of an insignificant specimen of mankind whose pride of place far over-reached his ability to serve.

I stated my mission and was asked if I had experience in the manufacture of small arms, and upon my stating that I had not, he informed me that my application could not be considered, as six months' to two years' experience in the different branches of the work were required to make one eligible.

I told him that although I seemed so sadly deficient in knowledge of small arms practice, I had a wide experience in machine work and by virtue of this felt competent to inspect, and under certain conditions, to direct the work turned out for the Government.

His answer was typical of his size and of a certain class of government clerk. He took me by the arm and with a great display of ceremony conducted me to a wall of the room where printed notices of different positions in governmental service were affixed. With more ceremony of the five-foot-two variety my attention was called to a clause in each of the several branches of inspection which stated that a certain term of months or years must have been previously devoted to the branch selected to make the applicant eligible as inspector.

I left that office with the impression that the mercenary butcher, baker, or builder of candle sticks who left his work to make shells was, because of his experience of six months or more in actual work on munitions, considered more competent to inspect that class of material than one who had been identified with the production of such mechanisms as machine tools, printing presses, and automobiles in both the shop and office the greater part of his life.

Now my capabilities as a Ryan, a Schwab, or a Stettinius have yet to be demonstrated; but like many others there are certain things that I am competent to do, among which inspection of parts may be rated a minor accomplishment. Private concerns who turn out work as complicated as that turned out for the government and who turn it out for other private concerns who are just as keen for accuracy as the government is, have found and still find merit in my services. They do not clamor for them but they are quite willing to consider them and have been known to avail themselves of them.

Was the governmental attitude in this instance based upon the fact that small arms manufacture is so vastly different from that of any other class of mechanism that actual experience is absolutely essential, or was it because of my disregard of the desirability of favorable outward signs when I hurriedly left urgent work to appear at that office in a guise akin to that of a tramp? If the first query is the case I have nothing further to remark, but if the second is true I would like to suggest that the five-foot-two standard of appraisal be removed and replaced by one of less restricted mental dimensions.

This is written as a possible explanation of the cases cited in your article in the issue of August 31st and not, as may appear at first glance, to uncover a little personal spleen relating to certain governmental clerks.

I am now, and always have been ready, as without doubt are a great many others who have had similar experiences, to assist in the task that confronts our country in any way that may seem advisable to those in authority; but I do not feel inclined to subject myself, voluntarily, to another such petty inquisition as I have described.

HAROLD R. HUTCHINSON.

Swampscott, Mass.

Adsorption

To the Editor of the SCIENTIFIC AMERICAN:

In the August 24th issue of the *Engineering and Mining Journal* there is an article on adsorption. The article has been condensed from a paper by W. D. Bancroft, professor of physical chemistry, Cornell University.

In reading the article, the thought occurred to me that perhaps the resistance offered to a vessel in passing through the water was due as much to the adsorption of the water by the sides of the vessel as to the roughness of the sides or to the shape of the vessel; that it was not sufficient merely to make the sides smooth to reduce resistance, but it was also necessary to coat the sides of the vessel with some substance or substances that do not adsorb the water—some substance that is not wet by the water.

Due to adsorption a vessel may drag along with it an enormous amount of water which in turn drags on the surrounding water, producing currents in it. It seems to me an intensive study along this line would give great results.

Adsorption may also be studied to great advantage in reducing the resistance of the air to airplanes and projectiles.

The author of the paper states all substances tend to adsorb on their surface any gas or vapor with which they come in contact. From this one is led to believe that in the case of airplanes and projectiles as in the case of a vessel, resistance may be due as much to adsorption as to roughness, that we may reduce the resistance to airplanes and projectiles by coating them with some substance that does not adsorb air.

I wonder if the substance that makes the fish so slippery isn't also a substance that does not adsorb water. And not adsorbing water makes it possible for the fish to go through the water faster. I wonder if the feathers of a bird are not a substance that offers but little resistance on account of not adsorbing air.

WM. CROCKER.

Prescott, Ariz.

Lengthening Ships to Increase Speed and Tonnage

To the Editor of THE SCIENTIFIC AMERICAN:

After reading your magazine for the month of April, about shipbuilding in the United States, one gets the impression that the output of "fabricated" steel ships will not commence at as early a date as is desirable.

It occurs to me that there must be a good many steamships whose speed would be improved by lengthening them besides increasing their carrying capacity at the same time. The cutting of the hull and the rejoining of it to the additional length would be a job for a dry dock and a shipbuilder. But the lengthening section could be fabricated in any bridge builder's or boiler maker's yard. If a knot an hour and a 5 per cent or 10 per cent increase of carrying capacity could be got at one and the same time it would seem that in this way (applied to ships whose lines show that lengthening would increase their speed) the greatest advantage would be taken of existing vessels, expert builders and "fabricators." Cutting a hull is a matter of hours. The "fabricators" would "get their hands in" on that part of a ship which might be turned out by a rolling mill and sold by the yard, for all the change in cross section that occurs in 50 ft. of it; and given suitable existing ships. I don't think any quicker way of effecting an increase in tonnage, with the means at your disposal, exists.

On the assumption that the fabricators have everything to learn about shipbuilding, that the bows and sterns which they will turn out will leave some room for improvement, for a while, it would seem wise to direct their energy to work they could do better and employ them on lengthening jobs to begin with, rather than set them at complete ships.

JOHN FREW.

St. Lucia, B. W. I.

The Whole Family Needs It

To the Editor of the SCIENTIFIC AMERICAN:

Enclosed find money order to amount of $4.00 for subscription to SCIENTIFIC AMERICAN.

The father of the family finds he "can't do without it." Two High School members of the family "have to have it." One member "wouldn't miss that star page for anything." And the small boy member says he "has to need it!" So—please send it to that family addressed to

JOHN O. MORRELL.

Knoxville, Tenn.

Hospitals like this one at Denver, Colorado, are being provided for the tubercular soldiers who return for recuperation

The Construction Division of the United States Army

The Vast Machine That Attends to Emergency Building for the War Department

By Col. W. A. Starrett, U. S. A., Chairman of the Committee on Emergency Construction, War Industries Board

NO discussion of the Construction Division is possible without immediately coming upon a great array of superlative facts and figures that, like other parts of our vast war preparation, fairly cloy the mind. Millions of this and billions of that keep recurring in never ending procession, and yet back of it all is a story of human interest that interweaves with business management, and engineering accomplishment, and accountability of stewardship to an expectant nation, that is well worth the telling.

The Construction Division is the vast war machine that attends to all of the emergency construction for the War Department. It is conducting about four hundred million dollars worth of work all over the country and has about as much in immediate contemplation, to say nothing of about three hundred million dollars worth already completed. The number of operations large and small runs into the thousands; everything from putting up a temporary shelter for a handful of troops to a great army base storage terminal costing thirty to forty millions. Its procurements run over a million dollars a day and its payrolls run into the millions a week. These are a few of the statistics that could be strung out indefinitely to indicate the hugeness of the task. Besides, its "Utilities" section undertakes the operation of these great enterprises after they are completed, so far as their general physical upkeep such as roads, water, sewers, lighting, heat, etc., are concerned; much as a landlord keeps up the property for his tenant. Thus, in a cantonment, the utilities are administered by the Maintenance and Repair Division of the Construction Division; the army coming into it finds it a complete city and in working order. The army remains there and occupies and uses the place and, upon being ordered away, leaves; the Construction Division remaining and continuing to run the place. Then, it is a great bureau of building and construction information. All departments of the army go to it for quick estimates of the probable cost of their proposed building undertakings. And so one part of it becomes a great estimating organization. But back of all that it is a great human institution complex yet simple, built around a single idea and that is, emergency construction for war purposes.

A chart of it looks all very geometrical with its engineering and accounting and administrative and buildings and procurement divisions, etc. Below that may be seen the various sections—groups of jobs under the direction of section chiefs with supervising constructing quartermaster officers under them, titles so formidable that we are apt to forget that these are just our big construction experts of other days who, at the call to war, dropped their accustomed occupations and hastened to Washington to enter the service for the common good. And this is why it has so much human interest and, in a measure, explains how it is all possible. The romance of the builder is as old as the world itself, and everybody's heart warms to the engineer whose constructive knack and will bend the forces of nature to his bidding and rear great structures out of the resources of the earth.

But the center of the whole interest is the aggregation of these men. Here is materialized the speculation that has always crossed the minds of those who have had to use their brains and imaginations in solving the complex problems that are the lot of every construction man. What if one could have his pick of all the best talent and vigor and vim of the industry, and what if he were called upon to apply it to some vast and complicated problem? What a wealth of conjecture the thought has always contained!

And here it is, almost come true, for in the Construction Division the Government has assembled a combination of brains and engineering and business skill the like of which never in all the world was assembled before and we hope never in the world again will be called, for only the call of a great war, threatening the nation's very existence, could bring these men together in the common cause of conducting the army's great building program with lightning rapidity, that our army may be assembled and supplied and munitioned without interruption.

The Division occupies a large part of one of the great temporary office buildings erected in Washington since the outbreak of the war. One passes from one department to another and hears bewildering talk of authorizations, and scheduling, and procurements, and estimates, and expediting and a hundred and one things that sound complicated and yet it is all rather simple. A bureau or branch of the army wants something built, generally in a tremendous hurry. The General Staff must approve it but, in order that that body shall have some notion of what it is all about, sketches and preliminary estimates generally have to be made. So we find the representatives of nearly all the bureaus—liaison officers they are called—bringing in for sketch and estimate their new construction requirements. These are quickly made and are sent by the Construction Division to the General Staff for review and approval. If favorable action is taken, the authorization is issued and the project becomes a fact. A contractor is nominated through the agency of the wide survey of the industry which the War Industries Board has been conducting since the beginning of the war. The job is assigned to one of the section chiefs, according to a certain predetermined classification, and notification is given to the scheduling department that counts and measures the things and materials to be procured. Moneys are set to the credit of the Construction Division, an account is opened for that job, the scheduling department notifies the procurement division of the wants, and the supervision of the actual construction is assigned to a constructing quartermaster who is posted off with instructions to start the contractor at work with such information as he has, details to follow. It is the constructing quartermaster's duty to look after all the construction work in the field, and he remains on the job till its completion.

THIS is the third of a series of four articles dealing with the Government construction work required by the war. The first article entitled "The Government's Vast Building Program" appeared in the issue of September 7th. "The Government Emergency Construction Contract" was the title of the second article. The fourth will deal with the subject of recommending a contractor.—EDITOR.

In passing from department to department where these things are going on one is always struck with the men. Here is one who was the chief engineer of a great railroad; here is a great water works expert; here is the general superintendent of a great building construction firm; here is a celebrated consulting engineer, etc.; an almost endless array of men of unusual capacity. And it takes more than just construction talent. Business men are to be found at some of the important posts where purely business decisions are needed; and we find a few lawyers, experts in contracts and real estate and laws generally that must be taken into account when so vast an undertaking is on foot. But the lawyers are not passing on legal questions—that is a function of the Judge Advocate General's department; they are doing administrative work where administration needs the aid that legal training can give. All these men are in uniform, all hard at work, adjusted and in working order to the requirements of the great machine of which they are now a part.

One is constantly reminded of what they all represent,

Copyright Underwood

Brig. Gen. R. C. Marshall, Jr., in charge of the Construction Division of the U. S. Army

for after all, we are looking only at the administrative machine. Far out there, scattered the length and breadth of the land, are the numerous construction organizations headed by similar men drawn from their peace time activities, now officers in the army and working as the tentacles of this great central organization. Every job has its representative at a desk in this great headquarters machine, and the hands of these representatives are stretched out touching the hands of the constructing quartermasters in the field, attempting to fill their diverse wants as these widely scattered projects are rushed to completion.

And on the other hand the Division touches hands with the War Industries Board and, through the building materials section, feels the pulse of the industries that are turning out the materials of which these projects must be built. Cement, lumber, steel, pipe, roofing, brick and tile, nails, plumbing supplies and a dozen other commodities fill the mounting columns of requirements, till the very capacity of the industries in some of these commodities is fairly exhausted. And the War Industries Board does more. It attends to the allocation of the materials and commodities to promote even distribution of industrial effort and, through its contact with the railroad administration, it arranges shipment schedules so that delays of delivery may be minimized. Priorities—that word that nowadays is commencing to place itself beside almost any activity we attempt—are taken care of by the War Industries Board to the end that the great necessary building program may rush ahead uninterrupted, at the same interfering as little as possible with all our other diverse war preparations.

It is interesting to follow the organization out upon the job. There in the field where the work is actually done a new fascination sets in; for the buildings themselves are, after all, the measure of the accomplishment, and moreover we get an opportunity to observe the working out of the emergency contract.

The supervisory and administrative function of the constructing quartermaster is intended to give freedom of action to the contractor in the exercise of his skill in organizing the work and his resourcefulness in overcoming difficulties. No more gratifying experience is vouchsafed an interested observer of a large construction project than to see an experienced constructing quartermaster working with a good contracting organization. They come to the job with a similarity of point of view. The technical points they both understand and, therefore, they talk a common language. They understand the orderly processes of organization and relative responsibility; the sense of stewardship on the part of the Government officer is met by one of strict accountability by the contractor; each has his duties and both work to a common end—the rapid and economical completion of the work.

The Construction Division's field organization will be large or small, according to the size of the work. On a cantonment the staff of the constructing quartermaster may run anywhere from seventy-five to one hundred and fifty people; supervisors, timekeepers, accountants, inspectors, field engineers, draftsmen, etc. It must be remembered that this is an arm of the Construction Division accountable to it in every detail and supported by it in its effort toward quick accomplishment.

The job organization reflects an important feature of the main office organization, and that is the theory of decentralization. Here we find the field forces working out the details just as the contract presupposes they will. In the main office, only indications and standards are worked out and the constructing quartermaster's organization at the site adapts them to the local conditions. Imagine the work it would take if this were not done. For example, the drainage and the adaptation of a camp to a difficult terrain would take months of intimate surveys and borings if it were to be attempted in the main office, yet at the site many of the problems can be settled by merely walking over the ground.

And yet the system of contact between the jobs and the Construction Division is such that the supervising constructing quartermasters can tell every day just how the jobs under their charge stand and, by systems of reports and close contact, they can direct and advise and uphold the constructing quartermasters in emergent situations that are constantly arising.

All contracts do not run without friction and, in the absence of a pre-explanation of what it is all about much adverse criticism is set afoot which is apt to do incalculable mischief. One of the difficulties of explaining the results so far obtained by this great Division in applying itself to the vast building program it is undertaking, is to present a proper mental yardstick by which the performance may be judged. At first the mind is fairly staggered by the hugeness of it all—even one

great operation has this effect.

Curiosity sometimes moves the observer to start intimate examination of the warp and woof of the fabric. Immediately he comes across a few rough spots. Instead of standing off to get another look at the picture he immediately produces a magnifying glass to investigate the closer. And so all perspective is lost, and perhaps another carping critic is made. Nor is the casual expert's testimony to be taken at face value until the worth of his observation has been tested.

Recently a high government official went to one of the cantonments in company with a builder who prided himself on his ability to size up a job quickly. The accomplishment was a matter of great pride to the official but as they drove around the job his heart sank for he knew that the great critic sat at his side and was silently observing the number of idle men that on every hand lolled around on the ground smoking and chatting, entirely oblivious to the great man's presence and certainly evincing no interest in the work. Finally the great official's patience could stand it no longer and, full of ire, he summoned the contractor and demanded to know the reason for so much idleness. The contractor, taken aback, could give no explanation and immediately sent for the head timekeeper to ascertain who the men were. The general contractor spent an uncomfortable few moments while the high official delivered himself of what he thought of him. The tension was broken by the appearance of an officer who, in no uncertain terms, ordered all the idle men to fall in. "Who are you," demanded the contractor. "I'm the provost officer," came the answer, "and I want all these draft men to line up for muster."

A bland smile of satisfaction from the contractor, a rapid change of the subject from the great expert and an abject apology from the high official closed the scene. It all goes to show that a job cannot be judged by appearance and one wants to be pretty careful of his facts before he starts any criticism.

It is not supposed that the work will always run smoothly and anyone who wants to treat the great building program as a bacteriological subject may find something to complain of. This is not said in any way to excuse or condone anything that goes wrong or is wasteful. On the contrary, the whole united effort of the Construction Division is directed toward speed of operation and economy of result. The point is, that the occasional story of the overpaid water boy should not be allowed to mar the splendid accomplishment.

In watching the organization work it is interesting to note how skilfully its machinery has been adjusted to allow latitude to the special abilities and requirements of the individual supervising constructing quartermasters. There are, of course, general rules and policies for the conduct of the work that all must abide by, but much individuality of management is nevertheless observed. Here, for example, may be a man of national reputation as a power house designer now in charge of a group including many power houses. He has his own charts and record forms and systems of keeping track; another in charge of a group which represents his former special training, depends more on photographs; another on time diagrams; and so it goes, a great system set up to get the best out of the competent experts who make up the organization, and also the best out of the contracting organizations that have joined hands with the Government in the fulfillment of this great task.

And so we have a picture of this great central machine, the Construction Division, standing as the base of the army construction program in this country, reaching out on one hand to every construction project whether it be in the deserts of Arizona or on a crowded water front of one of our seaports, and, on the other hand, supported by the War Industries Board with all the vast resources that it commands; and we realize that a mighty accomplishment in coöperation is being unfolded before our eyes.

A concentration of the
(Continued on page 261)

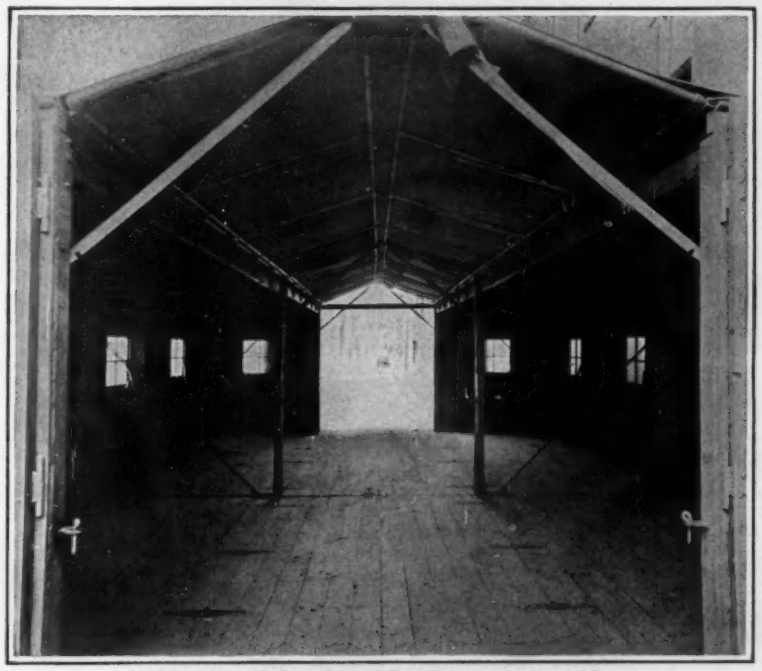
The mobile laundry on the road as a single train, hauled by the same power unit that runs the washing machinery

A Mobile Laundry Built Like a Sectional Bookcase

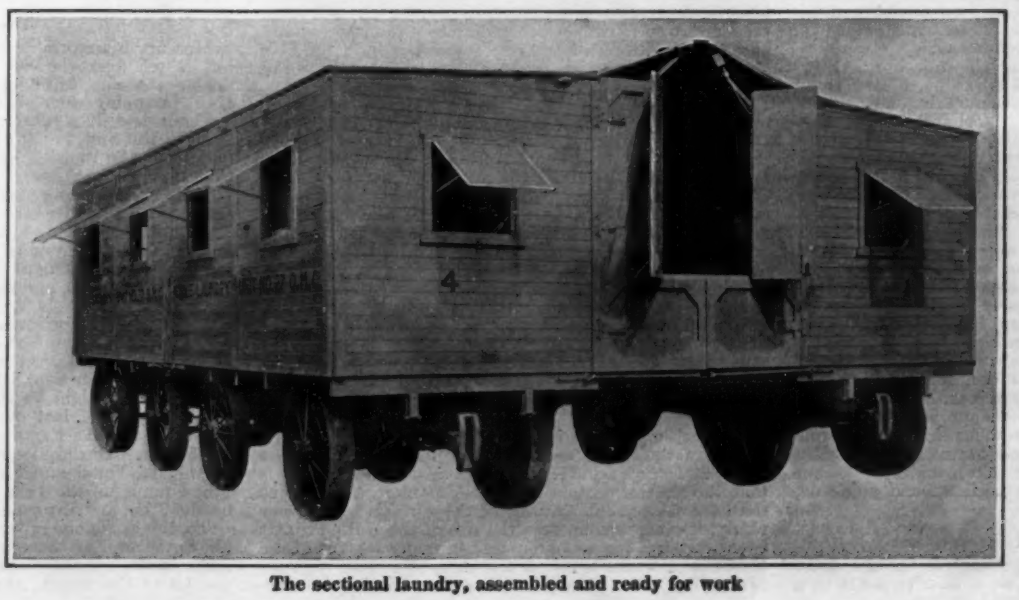
A DECIDEDLY new and interesting development of the trailer is the one which we illustrate. We have had portable houses before, houses which could be moved about and set up where they were wanted; but they have always been knock-down affairs. The idea of cutting a building into quarters, mounting each quarter intact on permanent wheels, and dragging these units off to a new location there to be fitted together without even being dismounted, is a combination of house-moving and portable-house technique which to the best of our knowledge has not previously been effected.

This accomplishment goes to the credit of an Ohio firm which makes trailers and nothing else. Accordingly it is their business to be right up to the minute in trailer possibilities; and when a call came for portable laundries to be used on the American front in France, they promptly developed the outfit which we illustrate.

In a very real sense we have here a house on wheels—on four independent sets of wheels, in fact. The four separate units are no more bulky than any ordinary truck or trailer, as is evident from the fact that they are drawn by a single power unit. When at rest, the washing machinery gets its motion from this same unit. Each section of the building has two adjacent sides of permanent wooden construction; the other two, meeting at the opposite corner, are temporary affairs of canvas, supplemented by hinged central members which make it possible for the assembled structure to have a width greater than the combined widths of two sections. With the temporary canvas walls removed from the two inner sides of each section, and the four fitted together like the members of a sectional bookcase, a laundry is formed large enough to care for the garments of 8,000 men at a single washing. Although our interior view does not show it, this is accomplished by aid of all the latest laundry machinery, with which the mobile sectional laundry is fully equipped. The outfit has given such excellent service that large repeat orders are now in the hands of the manufacturers.



Interior view of the sectional laundry on wheels, without the machinery



The sectional laundry, assembled and ready for work

The Lasting Benefits of Soil Blasting

BACK among the hills of Georgia an interesting experiment in subsoil blasting has been in progress for the past four years. The soil in this district is of a rich upland grade, and the subsoil is red and hard, with emphasis on the hard. In 1914 two acres were measured off. One was left for a check acre, the other was subsoiled with dynamite. Charges were exploded with blasting cap and fuse every 15 feet, 30 inches deep. This thoroughly shattered the hard, red clay, making cobweb fissures in all directions and thus permitting more water to enter than had before been possible. The roots also benefitted by the breaking up of the subsoil, new avenues being opened up for them to go out in search of plant food.

Both acres were planted to cotton in 1914. Both received the same cultivation and care, though the subsoiled one got a little more fertilizer than the other. The difference in this respect was not nearly enough, however, to account for the discrepancy between the yield of 1,804 pounds of seed cotton for the blasted acre and 912 pounds for the unblasted plot.

Corn followed in 1915. This year both plots received identical treatment and fertilization. They were both kept well worked and clean. The yield of corn in the husk was 2,614 pounds for the blasted acre, 1,894 pounds for the other. Owing to the wet weather, it was impossible to weigh the fodder; there were, however, 225 bundles on the blasted acre against 115 bundles on the check acre.

In 1916 the plots were in cotton again, and the benefits of the blasting were more pronounced than ever. From the very start of the growing season, the cotton on the subsoiled acre outgrew the other, and by midsummer it was at least twice as high. It also fruited much better than that on the unblasted land, and when the yield was measured it was found to have been exactly twice as productive—2,000 pounds against 1,000.

In 1917 corn was once more planted on the two test acres. The blasted acre yielded 42½ bushels of corn and three full loads of fodder; the unblasted acre, 35 bushels and scant two and a half loads of fodder. The conclusion was therefore forced that the blasting had been a profitable investment. The increased yields soon took up the initial cost, leaving all subsequent crop increases as net profit. This is good farming as well as good business.

Wood Cellulose as a Cattle Feed

EXTENSIVE experiments in Sweden have shown that wood cellulose is an excellent cattle feed, and the Swedish government is pushing its manufacture as much as possible. On account of the difficulties of exportation Sweden has a supply of about 500,000 tons. The Agricultural Society has requested the government to fix a maximum price for this feed of 22 crowns per 100 kilos ($5.90 per 220 pounds).

The Heavens in October, 1918

A Glimpse at the Earth from Other Worlds

By Prof. Henry Norris Russell, Ph.D.

EVER since it has been known that the Earth is but one of the planets which swing about the sun and shine by reflection of its light, and since the telescope revealed to us the forms and surface features of our neighbor planets, the question has risen: How would one's own planet appear to an observer at a distance? If beings with eyes like owls could exist on the Moon or upon the other planets, what would the Earth look like to them, whether with the unaided eye or with the telescope?

To give a full answer to this question is by no means as easy as might be supposed, but demands careful study. To eyes like our own, to be sure, it is certain that the Earth, as seen from the nearest planet, without telescopic aid, would look only like a brilliant star; but how bright would it be? To answer this question, we must know the reflecting power of the Earth, taken as a whole; and the only way of determining this is by measures of the brightness of the "earth-shine" on the dark side of the crescent Moon. Such measures are difficult to make, and of low precision; but those that have been effected so far indicate that the reflecting power of the Earth is much greater than that of the Moon, so that, seen from the same distance, the former would appear fully 40 times as bright as the latter, though the area of its disk is only about fourteen times as great.

With this as a guide, it is easy to calculate that the Earth in opposition, as seen from Venus, would be a truly splendid object, six times as bright as Venus ever appears to us; while the Moon, though far inferior to the Earth, would itself look, to the observer on Venus, as bright as Jupiter, and superior to any of the other planets, except perhaps Mercury under the most favorable circumstances. The system, as Professor Young used long ago to say, would look much more like a "double planet" than like any one of the outer planets, with its relatively tiny satellites. The Moon, at most, would get but half a degree away from the Earth, and the two would often get so close as to be difficult to separate with eyes like ours.

These figures apply to the view from Venus at her nearest. At other times when the Earth may be 100, or even 150, million miles from Venus, as against 25 million miles at the closest, our planet and its satellites would appear correspondingly fainter, closer together, and smaller in the telescope.

From Mercury, under the most favorable conditions, the Earth would look a little brighter than Venus at her best appears to us, while the Moon would exceed any star except Sirius.

From the outer planets, the Earth would be a far less conspicuous object, since it would be an inferior planet, always seen near the Sun, and showing only as a half-moon when farthest from the Sun in the sky. For a Martian observer, the Earth would be at its brightest when showing a rather wide crescent phase, and would then appear rather brighter than Jupiter does to us, while the Moon (which probably loses much more light than the Earth in passing from the full to the crescent phase) would be hardly brighter than the Pole-star. From Jupiter the Earth would be at most only 12 degrees from the Sun and, at elongation, would look like a star of second magnitude. Such an object would be likely to escape attention except during a solar eclipse; but total eclipses of the Sun by some one of the four greater satellites of Jupiter are of very frequent occurrence. If therefore intelligent beings could reside upon the cloud-covered surface of Jupiter, they would doubtless be aware of the existence of the Earth, though hardly of that of its inhabitants.

From the remote planets the Earth would look still fainter, and still nearer the Sun, until from Neptune it would be seen only as a faint star, two degrees at most from the Sun, and of fifth magnitude; but even from this remote viewpoint, it might be seen during a total eclipse of the Sun by Neptune's satellite, which is plenty large enough to produce such phenomena.

More interesting, however, is the question: How would the Earth look through a telescope, if seen from Venus?—or, what amounts to the same thing, how would it appear to eyes like ours, with perhaps the aid of a field-glass, if seen from the Moon?

To such a hypothetical observer, the Earth would present a broad disk, full of detail; but this detail would be extraordinarily unlike the occasional pictures of our globe which one comes upon in the work of various artists. These are not usually pictures of the Earth at all, and make no attempt to be; they are pictures of globes, of the sort familiar in our school days—pictures of maps and not of the planet. Especially are they often drawn surrounded by grotesquely impossible clouds, which would have to be thousands of miles long and wide if drawn to scale, while they are apparently floating in interplanetary space, with a complete defiance of gravitation but a nice consideration for the direction which happens to lie horizontally across the picture.

Before we start to work out the probable telescopic appearance of the real Earth, we must carefully free our minds of these conventional and harmless but wholly unscientific preconceptions, and take counsel, not from the artist, but, so far as his experience can guide us, from the aviator.

The Astronomer and the Airplane

There is no known way of getting far enough away from this planet of ours to enable a man to see it as a whole; but it is fortunately possible, nowadays, to get far enough away from a portion of it to gain at least some idea of its appearance from a greater distance. It has fallen to the writer's lot, in the course of duty of another sort than astronomical, to get a few glimpses of the world after this fashion; and some impressions bearing upon this astronomical question may well be set down here.

First of all, a very few flights will convince the observer that the Earth, viewed from a distance, must have a predominating bluish-white tone—white from the clouds, and to a lesser degree from haze; blue from the clear air, which draws a strong azure veil over the landscape, even directly below, when the observer is at a height of ten or twelve thousand feet, though hardly one-third of the Earth's atmosphere then intervenes between him and the ground.

Cultivated land, through this blue veil, takes on a rich green color, and forests, which themselves reflect much less light, are deep blue-green, the blue predominating, as most of the light comes from the intervening air. The sea, wherever the water is at all deep, would be almost black if it were not for the reflection of the sky from its surface. As things are, however, it is actually of a very dark blue, except when the Sun itself is reflected brilliantly from its waters. Even from a height of two or three miles the individual waves are almost lost, so that the water, where it reflects the sky, has the effect of a dark blue matt surface, while under the sun it resembles frosted silver. Both these effects must obviously be still more pronounced in the telescopic view from great distances.

All these impressions deal with the appearance of fertile country in clear weather, and when viewed more or less nearly at right angles with the surface—that is, near the center of the Earth's disk, when seen from some remoter point of view. Near the edge of the disk, even in the clearest weather, the light reflected by the air must so greatly exceed that which comes through from the Earth's surface that all the details of the latter would be lost in a strong bluish glare, which is both brighter and lighter in color than the region where the ground is seen more directly.

In regions with unclouded but hazy sky, some gray may be mingled with the blue; but of the duller grays of our cloudy skies and landscapes the observer on another planet would see little or nothing. He would have before him only the upper surface of the clouds—a sheet of almost pure white, brilliantly luminous if the Sun's rays fall on it in the right direction, or, if seen at another angle, flaked with lavender-blue shadows. These, from an astronomical distance, would merge into the general tone of the surface, without being separately visible. In comparison with the vivid brightness of these cloudy areas, the regions where the actual surface was visible would appear dark, and, as has been said before, distinctly blue, except in desert regions, where the overlying atmosphere could not mask the yellow color of the surface.

The Earth from a Great Distance

So much experience in our own atmosphere can teach us. How the larger features of the planet would appear we must learn by inference. The first obvious point is that the shifting clouds would be far more conspicuous than the permanent features of the surface. It is very rarely, if ever, that an area the size of the United States is entirely free from clouds; and in many regions of the Earth clear water is rather the exception than the rule. Moreover, these cloudy regions have a definite geographical distribution, which changes with the seasons. There would be great cloud-belts, extending almost around the Earth, in the region of the equatorial rains. In the desert belts near the tropics, the air would for the most part be clear, and these regions would appear as dark belts on either side of the white equatorial band; farther north and south, in the temperate zones, the surface would be mottled with cloud patches, great and small. As in our own latitude the prevailing winds are westerly, these patches would, on the whole, drift eastward in the direction of the Earth's rotation, so that, judged by the white spots, this region of the Earth would appear to have a shorter rotation period than the rest—perhaps by as much as half an hour. Still further north or south these regions of detached clouds would merge into the continuous white caps—snow, ice, clouds and fog—which would perpetually cover the poles.

Through the gaps in the clouds, the true surface features might be made out, but only bit by bit, and by painful labor. The coast lines would be conspicuous in some regions—as where the African or Chilean desert ends abruptly at the shore; but in well watered country the contrast between the blue-green of the land and the deeper blue of the sea would be far less pronounced. Seasonal changes should be easy to observe—the general change from greenish to brownish tones as summer passes into late autumn, the return of verdure in the spring, and, most of all, the winter snows (if these were not mistaken for clouds). But more conspicuous than anything else on the Earth's surface would be the reflection of the Sun from standing water. The brilliancy of this feature in any landscape is familiar to us all, and it is in no wise diminished in views from a great height. Whenever any part of the ocean is in the right position to reflect sunlight to an observer on another planet, and free from clouds, it must appear as a spot of light, of rather ill defined outline, and many degrees of longitude and latitude in diameter (on account of the spreading effect of the waves), but far brighter than anything else on the surface. Even in partly cloudy weather, glimpses of the reflected light would shine through the gaps between the clouds, themselves probably too small to be seen from far away; and lakes of no great size might thus be detected, if they happened to be carried by the Earth's rotation into the right position with reference to some watcher.

The principal outcome of all this discussion is that the Earth, viewed from a distance, must look remarkably unlike any of the other planets. Bluish-white in general color, as contrasted with the strongly yellowish light of the moon; showing in the telescopic view ill defined equatorial belts, and great scattered patches of brilliant white, on a background of a general blue-green tinge but brighter near the limb; and with the brilliant reflection of the Sun from the tropical ocean often, though not always, in sight; no one of the planets at which we can look resembles this at all.

At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.

At 9¼ o'clock: October 30.

At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens

As our map shows, the finest constellations are now in the eastern and western skies. In the latter we find Cygnus, still high, with Lyra and Aquila below; in the former are Auriga and Taurus, with Orion and Gemini rising below them, and Perseus above them. Cassiopeia, almost overhead, but a little to the north, and Pegasus and Andromeda, south of the zenith, form a link between the eastern and western groups, Draco and Ursa Minor are low in the northwest, and Ursa Major is almost out of sight on the northern horizon. The southern heavens are very dull, Fomalhaut, a little west of the meridian, and Beta Ceti, about thirty degrees to the eastward, being the only conspicuous stars.

The Planets

Mercury is a morning star at the beginning of October, but is too near the Sun to be well seen. He passes behind the Sun, through superior conjunction, on the 15th, becoming then an evening star.

Venus is still a morning star, but is getting pretty close to the Sun, rising only an hour before him in the middle of the month. She is still so bright, however, that she is easy to see.

Mars is an evening star in Libra and Scorpio, setting about two hours after the Sun.

Jupiter is in Gemini, and is in quadrature with the Sun on the 8th, crossing the meridian at 6 A. M. (true local time), and rising at 10.40 P. M.

Saturn is in Leo, and rises at 1.30 A. M. in the middle of the month.

Uranus is in Capricornus, and crosses the meridian at 9 P. M. on the 1st and at 7 P. M. on the 31st.

Neptune is in Cancer, and observable before dawn.

The Moon is new at 10 P. M. on the 4th, in the first quarter at midnight on the 12th, full at 5 P. M. on the 19th, and in her last quarter at 1 P. M. on the 26th. She is nearest the Earth on the 19th, and farthest away on the 5th. During the month she passes close to Saturn on the 1st, Venus and Mercury on the 4th, Mars on the 9th, Uranus on the 15th, Jupiter on the 25th, Neptune on the 27th, and Saturn again on the 28th.

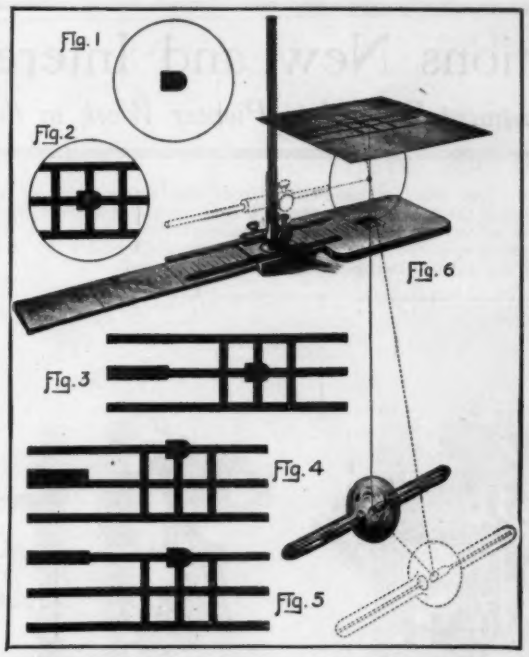
To the astronomers' vast relief, all the times quoted above, as well as these in the caption for our map, are again in the ordinary reckoning which goes into effect on the 1st of the month, and not in the "Summer Time."

Finding Bullets with the X-Ray

WHEN we entered the war, the dean of the Graduate Medical School of Tulane University urged the members of his faculty to devote careful attention to the special needs of the military surgeon in the preparation of their courses for the next session of the School. Following his natural bent, Dr. Amedee Granger, Professor of Radiology, investigated as thoroughly as he could the reports which had appeared in the American, French and English X-ray journals upon the localization of foreign bodies, as practiced on the European battlefield. The result of that study may be briefly summarized as follows:

The fluorescopic method of examination is universally employed. The number of trained and experienced radiologists is far below what is needed. The number of the devices in use is about in proportion to the number of expert radiologists in the service, as most of these men employ either their own devices or their own modifications of some one's else device. While all are accurate, making use in one form or another of the triangulation principle, the large majority are complicated, and require for their proper use a technical knowledge and skill not possessed except by the highly trained operator. With the large majority of these devices the time required for the localization is too long for them to be of very great service except at base hospitals in the rear of the battle front, where time is not such an important factor.

Accordingly, in spite of the comparatively large number of devices already in use, there seemed to be plenty of room for one which would be simpler in construction and especially simpler in use, so that any physician, regardless of lack of previous experience with the X-rays, could master the technique in a short time; and it seemed above all that one might be developed requiring so few manipulations that the localization could be accomplished with it in a very brief interval.



The Granger X-ray localizer for finding bullets in the body, and the appearance of the fluorescent screen at each stage of the operation

As the result of experiments carried on in his laboratory along the lines suggested, Dr. Grange is now ready to present a small device which fills all these requirements of accuracy, speed, and simplicity. Its general construction is clear from our drawing. It must, however, be stated that the little square hole in the base plate is crossed by perpendicular bars which, with the sides of the hole itself and with longitudinal markings on the bottom of the aluminum plate, make the gridiron pattern whose shadow is seen on the fluorescent screen. The latter is not a part of the apparatus proper, but is put in place separately and held rigidly from a separate stand. It goes above the patient, while the base plate of the localizer goes beneath him. The pointer which moves up and down on the vertical arm, it should also be specified, is exactly in a vertical plane with the central longitudinal bar in the little square hole.

To locate a foreign body it is necessary to have, besides the assembled localizer, a transparent-top table and a holder or box of some kind for the X-ray tube, provided with a diaphragm. Then there must be some arrangement for moving this holder under the table, as well as for fixing it in a given position. The range of this movement need not be great; a foot will suffice for every possible case. The patient is placed on the table, the wounded part lying over the X-ray tube-holder, and the fluorescent screen is put in position above him.

The diaphragm of the tube-holder having been previously closed so that there appears upon the screen a circle of fluorescence no more than two inches in diameter, the tube is shifted about until the shadow of the foreign substance is seen lying in the very center of this bright area (Fig. 1). It is understood that the localizer has not yet been put in place.

This is now done—the base plate is slipped under the patient; and it is moved back and forth until the shadow of the intersection of the cross within the square falls accurately upon that of the bullet. We will then have some such appearance as is shown in Fig. 2.

The diaphragm of the tube-holder is now opened, so that the shadow of the complete gridiron appears on the screen, as in Fig. 3; and it will be noted that the shadow of the pointer, off at the left, must necessarily fall along that of the long central bar. The tube is then moved, as indicated by the dotted outline in Fig. 6, until the shadow of the foreign body leaves that of the central point of the cross and moves over into an identical position with reference to the shadow of one of the lateral guides. This shifts the shadow of the pointer also; but as the pointer itself is not at the same height as the foreign substance in the patient's body, it will not move the same distance, but will take up an undetermined position somewhere between the central and the lateral guides. All this is indicated in Fig. 4.

As the last step in the adjustment of the localizer, the pointer is now moved up on the vertical standard, by turning the little thumb-screw, until its shadow does fall centrally upon the lateral guide (Fig. 5). Its new position is indicated by the dotted outline in Fig. 6.

The situation is now at the operator's mercy. For the pointer in its final position lies on the same horizontal plane as the bullet, while the latter is directly above the center of the grating. Accordingly the intruding bit of metal is precisely located at the intersection of two imaginary lines which may be projected through the patient's anatomy. To facilitate the subsequent operation, these lines are plainly indicated; the pointer is pushed forward to make one mark on the skin, while a little needle is thrust up from below, through a tiny hole in the intersection of the central ribs in the square hole, to make another mark; and this gives a record of the bullet's position which cannot be misinterpreted.

These points can be marked later with nitrate of silver, but even this is not the extent of the certainty which Dr. Granger's localizer affords the surgeon. For the horizontal and vertical scales indicate the distances of the bullet from the two marked points, so that the operator does not have to reconstruct in his imagination the lines through the patient's body joining these points. He can cut straight in from either point to a known distance in the secure knowledge that at that distance he will find the fragment he seeks; or if it is expedient to cut in from some other point, he can in a moment calculate how far he will have to penetrate from there.

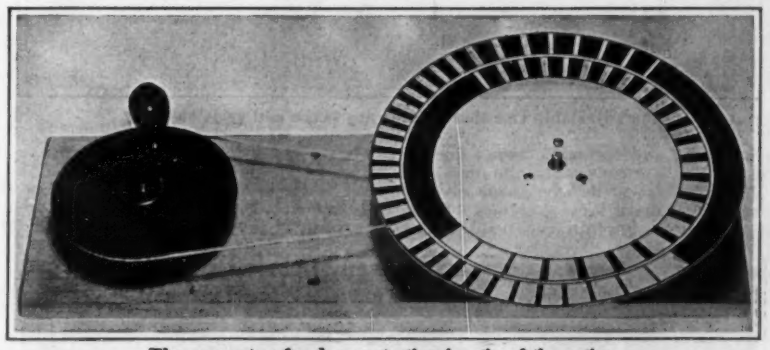
In a test case Dr. Granger adjusted his localizer according to the successive requirements of Figs. 1-5 in forty-five seconds. Marking the skin and reading the scale could hardly consume more than another fifteen seconds, or at the outside 30, so that the whole procedure would be begun and finished well within a minute and a half. That the apparatus is not an impractical bit of fancy theory is amply demonstrated by the following report, quoted from Dr. E. L. Lackert of the regular staff of the Tulane Medical School.

"When Dr. Granger advised me that he was preparing a device for the localization of foreign bodies, I suggested that we test it, when completed, on a patient with a bullet in his hip, which Dr. Friedrichs and I had made an unsuccessful attempt to remove. This patient, a stocky, muscular boy of 19 years, was shot accidentally about a month and a half prior to the operation by a person standing 20 feet away facing his right side. The bullet, a 32-caliber, entered the right hip, one and a half inches below and one and a half inches posterior to the anterior-superior spine of the ilium. An X-ray (anterior-posterior) located the bullet on the ilium just above the head of the femur. Being assured that the picture designated the bullet as being anterior and as the patient complained of tenderness under Poupart's ligament and thought he could feel the bullet in this location, we felt confident of locating the bullet in here.

"After a thorough search of about an hour and a half through a large incision, we were unable to locate the bullet. A piece of silver wire was inserted in the wound its end resting against the ilium where we thought the bullet should be and an X-ray requested taken in a semi-lateral position, and as the vertical rays fell in the same plane as the wire, the loop of wire outside the wound was all that appeared in the picture, and no further information was obtained as to the location of the bullet.

"With the localizer described, the bullet was shown three and a half inches back of the incision which had been made on the lateral aspect of the hip; it was in fact on the posterior aspect of the ilium. Numerous

(Continued on page 262)



The apparatus for demonstrating inertia of the retina

The Inertia of the Eye

By J. Fidel Tristan and Gustave Michaud
Costa Rica State College

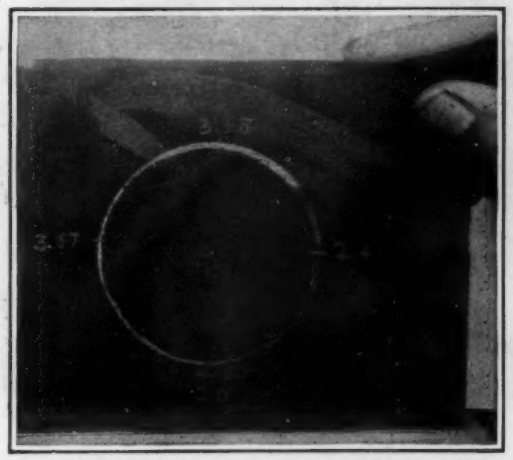
THE two circles painted on the periphery of the disk illustrated herewith are identical, so far as the relative amount and distribution of light and shade are concerned, yet, if the disk be rotated in the direction of the hands of a clock, the outside circle becomes nearly white, while the inner circle becomes much darker. If now the direction of the rotation be reversed, the opposite phenomenon takes place: the outside circle becomes dark and the inner one more luminous. Now, a glance at the distribution of light and shade on the two circles shows clearly that a reversal in their direction of rotation makes but one difference in the field of vision of the observer; *i. e.:*

When the disk is rotated clockwise the luminous impression produced by the white area of the outer circle *begins gradually and ends abruptly*. On the contrary, the luminous impression caused by the white on the inner circle *begins in the way of a shock, abruptly, and ends gradually*. If the disk is rotated in a direction contrary to that of the hands of a clock, the whole set of phenomena is reversed.

This experiment seems to us to show conclusively enough that equal amounts of light may determine widely different quantitative impressions on the retina according to their way of striking it, such impression being much greater when the light gradually increases to a maximum than when it suddenly starts with its maximum intensity. These phenomena are not unlike two different attempts which might be made to move a heavy stone with the foot, in one case by gradually increased and successful pressure and, in the other, by a tremendous and useless kick.

For this curious phenomenon we propose the name of "retinian inertia". While this name is not, by itself, an explanation, it may lead to it and recalls a striking analogy between this and other mechanical and physiological phenomena.

Retinian inertia does not seem to be the same for the various wave lengths of visible light, as one of the two circles ordinarily appears tinged with a bluish or grayish hue while the other takes a peculiar yellowish or brownish or greenish tint. Moreover the experiment is most striking when the shades are painted with China ink on a yellowish paper.



The growing tendril marks its course in the wood

The smoked glass plate is fastened above the plant

Recording the Movement of a Climbing Plant

A VERY good way of finding out the manner in which a twining plant grows is shown in the accompanying pictures. A sheet of smoked glass was supported just above the tip of a climbing Lima bean plant. The tip of the shoot then marked out its course on the smoked surface, and it was easy to secure a record of the time taken to complete a revolution. The plant was closely watched, and as the stem reached certain points the hour and minute were painted on the upper surface of the glass.

The glass was placed in position at two o'clock. A quarter of the circle had been traversed by two-forty, at three-eighteen half the distance to be journeyed had been accomplished, at three-forty-seven three-quarters, while by four-thirty-five the tip of the shoot was back at the starting point.

The experiment was extended to show that the rate of growth was much higher in warm weather than in cool. Thus under a temperature of 90 degrees Fahrenheit the circle was completed in a little more than two hours and a half, whereas when the thermometer stood at 75 the time was three hours forty minutes. With the temperature at 60 degrees the tip required five hours for its tour.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Vise that Fastens Anywhere

THE majority of vises are stationary or demand certain conditions for making them secure. A new chain-grip vise can be mounted in a very short time to any support no matter whether vertical, inclined or horizontal. The supporting chain has one end fastening to the base of the vise. This passes through the tightening eye-bolt of a clamp support, located at the back of the column, and by having one link dropped into a recess on the opposite side of the vise base it is ready for the tightening of the eye-bolt, which makes it secure to any support, round or square.

The vise grips the work between a staggered jaw and a gear chain of bicycle type; this chain is caught on a little jaw above the work, and forced out around the piece by pressure of a bill-crank lever beneath. It is quickly moved from one location to another and is easily operated by a push on the handle. It is being used extensively on pipe and conduit work, as it is portable, ready for an instantaneous worker and saves much time by eliminating the carrying back and forth.

An Efficient Underfeed Stoker

ALL modern power plants are equipped with mechanical stokers because by their use the cost of labor is reduced, less fuel is required, smokeless combustion is secured, and the boiler capacity is materially increased. One man with a good stoker and proper facilities for handling the coal and ash can fire several thousand horse-power of boilers—something clearly impossible with hand-fired furnaces. It is desirable to employ a higher grade of labor than in a hand-fired plant, because the work is mainly one of machine supervision. Nevertheless, even in the smallest establishments, the greater reliability and smaller cost of furnace repairs warrants the use of stokers.

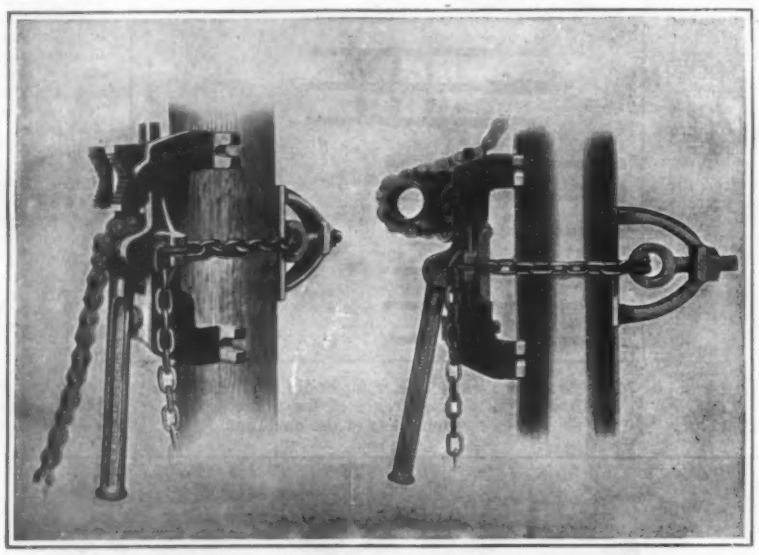
Just as there is no one type of prime mover that will best serve for all purposes, so is there no one type of stoker which is best for all fuels and all operating conditions. In many modern plants it is necessary to carry high peak loads for considerable periods. For such service the underfeed type of stoker is peculiarly suited, because it is capable of efficiently burning enough coal to evaporate three or four times the rated water capacity of the boiler.

When bituminous coal is introduced into a furnace, its temperature must be raised to the kindling point before chemical combustion can begin. This increase in temperature results first in the distillation and combustion of the volatile matter; and combustion of the remaining carbonaceous portions of the fuel follows. The fundamental principle of the underfeed stoker consists in forcing the fresh coal beneath a bed of incandescent fuel, so that the distilled volatile must pass through a high temperature zone before entering the furnace proper. While all underfeed stokers operate on this general principle, the method of introducing the air, the construction of the tuyeres and grates, and the slope of the fuel bed, all have an important effect upon the results obtained.

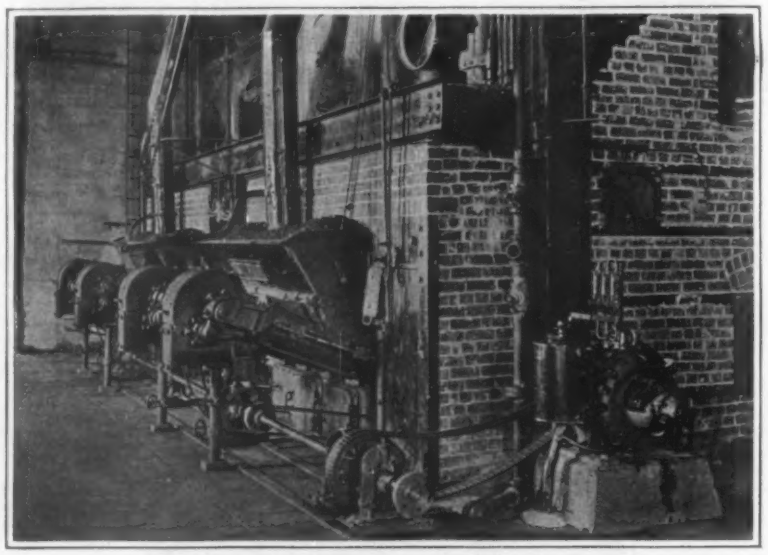
The underfeed stoker illustrated is made up of a series of inclined retorts, each consisting of a fuel trough and two parallel tuyere boxes. The fuel fed into the hopper drops in front of the cylindrical ram when the latter is in its outward position. On its inward stroke the ram pushes the coal ahead of it into the furnace and beneath that previously introduced. After combustion is practically completed, the backward movement of the ash is continued by means of the moving grate, which reciprocates immediately below the lower end of the tuyeres. These grates are driven from the main rams by means of lost-motion connections.

The air, at the highest pressure employed for the given rating, enters directly under the front part of the stoker. Secondary air enters from the air-distributing box through a number of orifices extending the entire width of the furnace, and mixes with the carbon monoxide to give a more thorough mixture of gas and air than can be obtained by other means. The proper volume of air at a lesser pressure is admitted to the lower end of the fuel-bed, the decrease in pressure and volume being arranged to suit the decreased thickness and combustible percentage of the fuel-bed. As this arrangement supplies each part of the fuel-bed with the correct amount of air at the correct pressure, less air is required per pound of coal; hence the furnace temperature is increased and the stack losses due to excessive air are cut to a minimum.

It is claimed to be fundamentally incorrect to admit large volumes of air to the relatively thin fuel-bed at the rear, as this results in excessive supply here and deficiency at the front. The excess air at the rear is supposed to mingle with the combustible gases from the upper part of the fuel-bed; but in actual practice it does not do this satisfactorily. From this follow the advantages claimed for the stoker described and illustrated.



The adjustable vise that fastens anywhere and grips anything



An electrically operated underfeed stoker

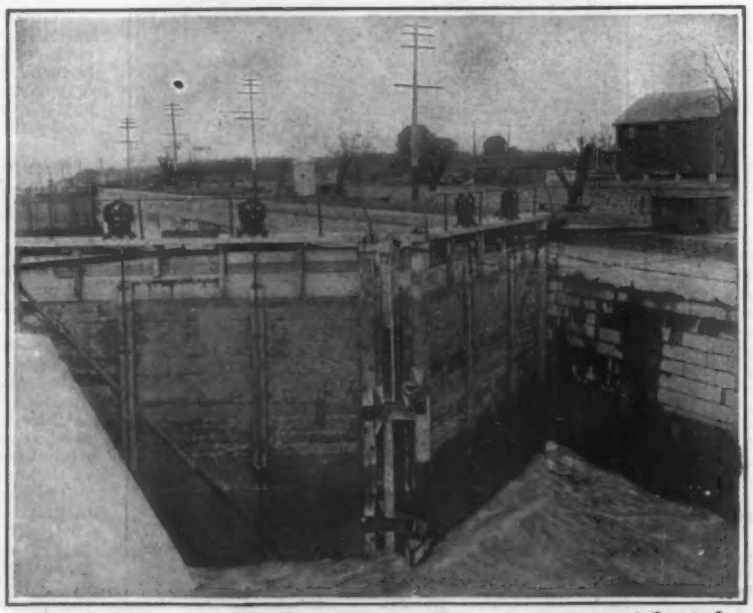
Locking the Locks

IT is obvious enough that the gates of a canal lock must withstand great horizontal pressure from the load of water which they carry; but perhaps it is not so clear that they have also to resist a very material up-and-down thrust. The fact is that in a busy canal the normal state of affairs is the emptying or filling of the lock chambers; and these processes, both on their own grounds and by aid of the strong eddies and whirls which they cause in the ends and corners of the locks, exert against the faces of the gates a lifting or a depressing force, as the case may be, which is far from negligible.

In the ordinary type of miter-jointed leaf gate, opening at the center, this state of affairs is aggravated by the tendency of the leaves to open at the center when the lock is full, either from wind or from surge or, occasionally, when struck a blow by a ship that has got momentarily out of control. With the gates closed and locked, it is hardly possible for them to yield to the vertical thrust of the water; but when they are sprung outward a bit at the miter, either leaf is free to respond without the necessity of dragging the other along after it, while the upward or downward thrust is itself strengthened by leakage of water through the partly open joint.

A Canadian inventor, N. W. Gowan of St. Catherines, Ont., has developed an ingenious attachment for preventing all this, and locking the gates firmly together in their proper vertical relation. It is simple enough, consisting, as our illustration shows, merely of four stout metal horns, two exterior on the one leaf and two interior on the other. In this way it is made impossible for either leaf to move up or down, even when the leaves are considerably sprung; for the horns remain engaged, by virtue of their length and slight curvature, until the miter joint has been swung pretty well open.

This device has been adopted by the Dominion Government, and has been put in service in the Welland Canal. Eleven of the locks here are equipped with it, and it has been successful under conditions which have tested it severely. We illustrate it in operation in one of the largest locks of the Welland chain.



When locked with these little horns, the canal gates cannot be carried out of place by the swirling water

Megaphones with Rectangular Apertures

A RECENT paper read before the Chicago section of the American Physical Society by Mr. F. R. Watson describes some interesting experiments with megaphones having rectangular apertures. Rayleigh was one of the first to make experiments with apertures of varying section, including elliptical types, which appeared to possess certain advantages for fog-signalling. The author has extended these speculations to megaphones with rectangular apertures for conveying speech. When the horn was held with the long edge of the rectangular aperture vertical sounds were diffracted more than 90 degrees from the straight forward direction and were easily heard by observers at the side. A converse effect was noted when the long edge of the rectangular aperture was horizontal. It is suggested that such megaphones would have particular applications for addressing crowds, for phonographs, etc., where it is desired to spread the sound horizontally. The results also throw an interesting light on the mean wave-length of speech. The sound was diffracted by the narrow dimension of the aperture, but not the large one, and must therefore have an effective component with half its wave-length lying between these limits.

A New Regenerated Rubber

OBJECTS made of a new regenerated rubber product, called "Agatit," were shown by the German Prof. M. Le Blanc at the April meeting of the Bunsen Gesellschaft. This product has been worked out in the institute for physical chemistry of the University of Leipzig, by Le Blanc and Luttke, in conjunction with industrials. It is supplied either in a fine emulsion or colloidal solution, which is convenient for many applications, or as a solid. The latter is much used, it was stated, in packing for condensers and on U-boats. It also serves as a substitute for leather, and is in one respect superior to rubber for this purpose, because it can be nailed and sewn, which is important for sole leather. Rubber gloves for medical men and feeders are also made entirely or largely of agatit. It was mentioned that rubber gloves were hardly obtainable at all in Germany now, while these new gloves cost only 2.50 marks; it is doubtful, however, whether this figure meant the estimated cost of manufacture or the sale price.

... and in the U. S. Army, here and overseas

A fact:

From all accounts, the most eagerly sought-for cigarette among American soldiers abroad is Fatima. Exact figures to prove this are not available; but, in view of Fatima's known popularity with both officers and men still in training on this side of the water, it would seem to be correct. Below are printed a few typical reports on training camps and army posts, received from our salesmen in August:

FORTRESS MONROE, Old Point Comfort, Va.
"Fatima leads in sales"

WEST POINT, Officers' Club:
"More Fatimas smoked than any other cigarette"

ROCK ISLAND ARSENAL, Rock Island, Ill.:
"Fatima is second best seller"

CAMP MERRITT, Dumont, N. J., Officers' Club:
"Fatima is largest-selling cigarette"

CAMP ZACHARY TAYLOR, Louisville, Ky.:
"Fatima is most popular high-grade brand"

CAMP UPTON, Yaphank, N. Y.:
"Fatima is called here 'the officers' cigarette'"

CAMP GORDON, Atlanta, Ga.:
"Fatima is one of the best sellers among the better brands"

CAMP SHERMAN, Chillicothe, Ohio:
"Fatima is second biggest-selling cigarette"

CAMP MORGAN, Mobile Bay:
"Fatima is leading seller here in its class"

FORT WADSWORTH, N. Y.
"Most officers smoke Fatimas; very popular also among the men"

FORT SILL, Oklahoma, "School of Fire":
"Fatima is second in point of sales"

CAMP SHERIDAN, Montgomery, Ala.:
"Fatima outsells all other high-class brands"

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"Fatima is by far the biggest-selling cigarette in camp"

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"The Smooth Finish of this used Firestone Rim Shows No Signs of Rust"

Splashing through the sloppy country roads and over the wet pavements of the city—the ordinary rim soon gives up to rust.

Then the roughness of the rim begins to chew the beads on the tire—the rust eats into the rubber—and unless quickly attended to the tire is ruined altogether.

To save their customers from this costly experience the Firestone Tire and Rubber Company rustproofs Firestone rims with the Parker Process.

The Parker Process protects Firestone rims from rust—and as result your Firestone rim is as smooth the day you remove it from your car as the day it left their plant.

Firestone
RIMS

This illustration shows a truck load of Firestone rims immediately after going through the Parker Process. Note the smooth rustproof finish.

In the same way that the Parker Process improves the service of Firestone rims it adds to the life and efficiency of many other products which are a part of your daily life. Among the metal articles which are now made proof against rust by the Parker Process are: Building Supplies, Automobiles, Motor Trucks, Motor Accessories, Electrical Equipment, Typewriters, Farm Implements, Ranges and Stoves, Steel Furniture, Sporting Goods, Phonographs, Dental Supplies, Railway Supplies, Telephone Equipment, Ornamental Iron Work, Arms and Ammunition.

Will Your Own Product Successfully Resist Rust?

Will your own product successfully resist rust or are you compelled to deliver it to your trade with the tacit admission that sooner or later it will begin to corrode and waste away in service?

To find out how the Parker Process will help you improve your service to your customers—and how easily you can adopt it for your product without in any way interfering with your present production plans write for the new Parker Process book—a plain practical talk on rustproofing for manufacturers and industrial executives.

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DETROIT, MICHIGAN, U. S. A.

PARKER PROCESS
RUST PROOFS IRON AND STEEL

RECENTLY PATENTED INVENTIONS

Pertaining to Apparel

GARMENT STRETCHER AND PRESSER.—L. J. WIDNESS, 208 Van Buren St., Brooklyn, N. Y. Among the ojects of the invention is to provide a device for holding a pair of trousers in such a manner as to form and maintain creases at the front and back of the legs and to apply sufficient tension to remove all wrinkles or bagging, another object is to include a nozzle in the form of an auxillary bar for supporting an extra pair of trousers as well as a coat and vest.

GARMENT HANGER.—J. F. WILLIAMS, 254 W. 95th Street, New York, N. Y. The invention relates to garment hangers of that type comprising a pair of relatively movable bifurcated gripping members which are adapted to engage with the bottoms of trousers legs to hold the trousers stretched in inverted position, although the device may be also used for supporting skirts from the waist.

Electrical Devices

ELECTRIC FLASHER.—J. WALTON, Phoenicia, N. Y. The invention relates to electric signs, and deals particularly with means for automatically opening the electric circuit of the sign lamps at any predetermined time. A specific object is the provision of a combination of flasher and cut-out switches which are operated by an ordinary alarm clock mechanism, whereby one of the gear wheels can be used to operate the flasher switch and the hammer of the alarm can be used for operating the cut out switch.

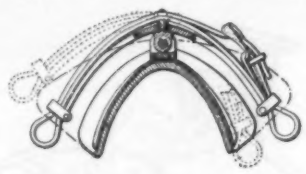
ARC LAMP.—E. S. PORTER, Precision Machine Co., 317 E. 34th St., New York, N. Y. The invention has particular reference to the carbon holding and feeding means, which present a plurality of rolling supports to a carbon. An object is to provide means for rapid manipulation of a carbon, said means automatically clamping the carbon in a yielding manner and automatically accommodating themselves to carbons of different diameters and to changing the speed of movement of carbons of different diameters.

RECHARGEABLE DRY CELL.—M. G. YOUNG, care of Lawrence Club, Lawrence Park, Erie, Pa. The general object of the invention is to provide a cell construction whereby the cell when exhausted can readily be refilled at little expense. A more specific object is the provision of a cell in which the shell can be easily taken apart, so that after the cell is exhausted the zinc shell or casing can be removed and cleaned and again put together so as to be refilled.

Of General Interest

DUMBWAITER SAFETY DEVICE.—F. WELLER, 4611 Park Ave., Bronx, N. Y. The invention relates to safety devices for dumbwaiters to prevent the dropping of the box in case the suspension cable should break. A specific object is the provision of a clutch element or lever mounted on the top of the dumbwaiter and connected with the suspension cable, whereby the latter when in normal condition holds the clutch element released, the connecting device between the clutch element and suspension cable having means whereby the suspension cable is free, should the cable break the clutch, is automatically thrown into engagement with one of the guide rails to prevent the dumbwaiter dropping.

NECK PAD.—B. E. PICKETT, 405 Linn St., Yanktown, S. D. The invention relates generally to harness, the object being to provide a neck pad adapted to be arranged between the collar



A SECTIONAL VIEW OF THE DEVICE

and the hames, for permitting free movement of the hames without rubbing the neck of the draft animal. The device is adapted to be arranged between the meeting ends of a collar on the horse's neck.

ROTARY TOOTHBRUSH.—M. STOORMAN, 749 Tremont Ave., Bronx, N. Y. Among the objects of the invention is to provide a rotary tooth brush adapted to brush or cleanse by single operation or series of movements all the exposed surface of the teeth, inside, outside and edges of the teeth of both jaws simultaneously. The device comprises spaced parallel disks the inner flat faces of which are provided with bristles, the handle is offset from the head to accommodate the operator's lips or cheek, and is bent to provide rotating or crank action.

TRAY ATTACHMENT FOR HIGH CHAIRS.—J. E. HEULE and G. GRAHAM, Superior, Wis. The invention has for its object to provide an attachment for high chairs, wherein an enameled metal tray is provided capable of being attached or detached to the usual wooden tray, the metal tray being designed for a food tray, leaving a wooden tray when the metal one has been detached.

MATCH SAFE.—O. KARTEMARK, 28 Whitney Ave., New Haven, Conn. Among the objects of the invention is to provide a single delivery match safe with a delivery controlling device. A further object is to provide a construction having inner and outer telescopic sections the latter of which is adapted to be fixed rigidly to its support insuring that the match safe will not be accidentally dropped, and to provide a top or lid construction constituting a part of the fixed casing.

NAPKIN OR BIB FOLDER.—J. R. PARRISH, Nashville, Tenn. The general object of the invention is to provide mechanism of the character specified for supporting a child's bib in proper position without the use of strings or pins, and so arranged that it may be easily

A FRONT VIEW OF THE HOLDER IN CLOSED POSITION

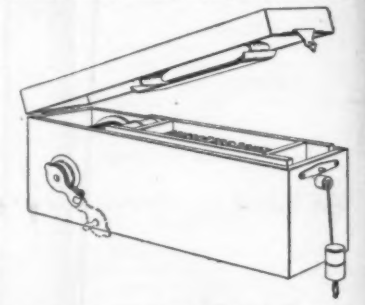
placed or removed, and which permits the use of a rectangular piece of cloth without the usual cut-out in the neck. The device is formed by wire bent into shape, with clamping members connected at one end by a resilient coil.

BATH ROOM FIXTURE.—E. BERKO, 192 24th St., Brooklyn, N. Y. This invention relates to bath room fixtures such as soap dishes, towel racks, tumbler holders, or the like. Among the objects is to provide a manner of assembling adjacent parts of fixtures made of porcelain, vitreous china, glass, or the like, and to provide means to connect the fixtures to the wall in an invisible manner and thereby avoid the unsightly appearance of bolts, screws, or other fastenings.

ANIMAL POKE.—J. FAY. Address John E. Foley, Ellsworth, Wis. An object of the invention is to provide means whereby an animal can be stamped or branded with the owner's name, to save the burning of the hide and consequent depreciation of the price when it is sold. A more specific object is the provision of a device which embodies a double wire sharpened at one end so as to be pierced through the neck of the animal, and on the wire is fastened a body which is large enough to bear the stamp of the owner, and also which contributes to render the poke effective in preventing the animal from escaping through fences or the like.

Hardware and Tools

CARPENTER S MARKING LINE.—T. ISABAKI, 2931 Girard Ave., Philadelphia, Pa. This invention deals particularly with a device which embodies a reel within a housing, and a coloring means embodying a pad over which the



A PERSPECTIVE VIEW OF THE IMPLEMENT

line travels, and a wad pressed against the pad and line by a yielding follower carried by the lid of the case, while in the body of the casing is held the pad and wad and coloring-means to be deposited on the line, and transferred to the work to be marked.

LOCK.—A. KIRSCH, 760 Lexington Ave., Brooklyn, N. Y. The invention relates to door locks consisting of a key-controlled cylinder lock at the outside of the door and controlling a latch on the inside of the door. The object is to provide a lock arranged to permit of fastening correctly in position on either a right or left hand door, at the same time insuring proper alinement of the cylinder lock and the catch lock.

VALVE.—A. E. RASMUSSEN, 804 So. 10th St., North Yakima, Wash. The invention relates to valves for closing or opening a surface opening on a conduit, and is particularly adapted to irrigating conduits. An object is to provide a valve which can be easily and quickly applied and operated on pipe lines in irrigation systems, provision being made for controlling an aperture on the surface of a conduit so that the size of the orifice may be varied to obtain the desired outflow.

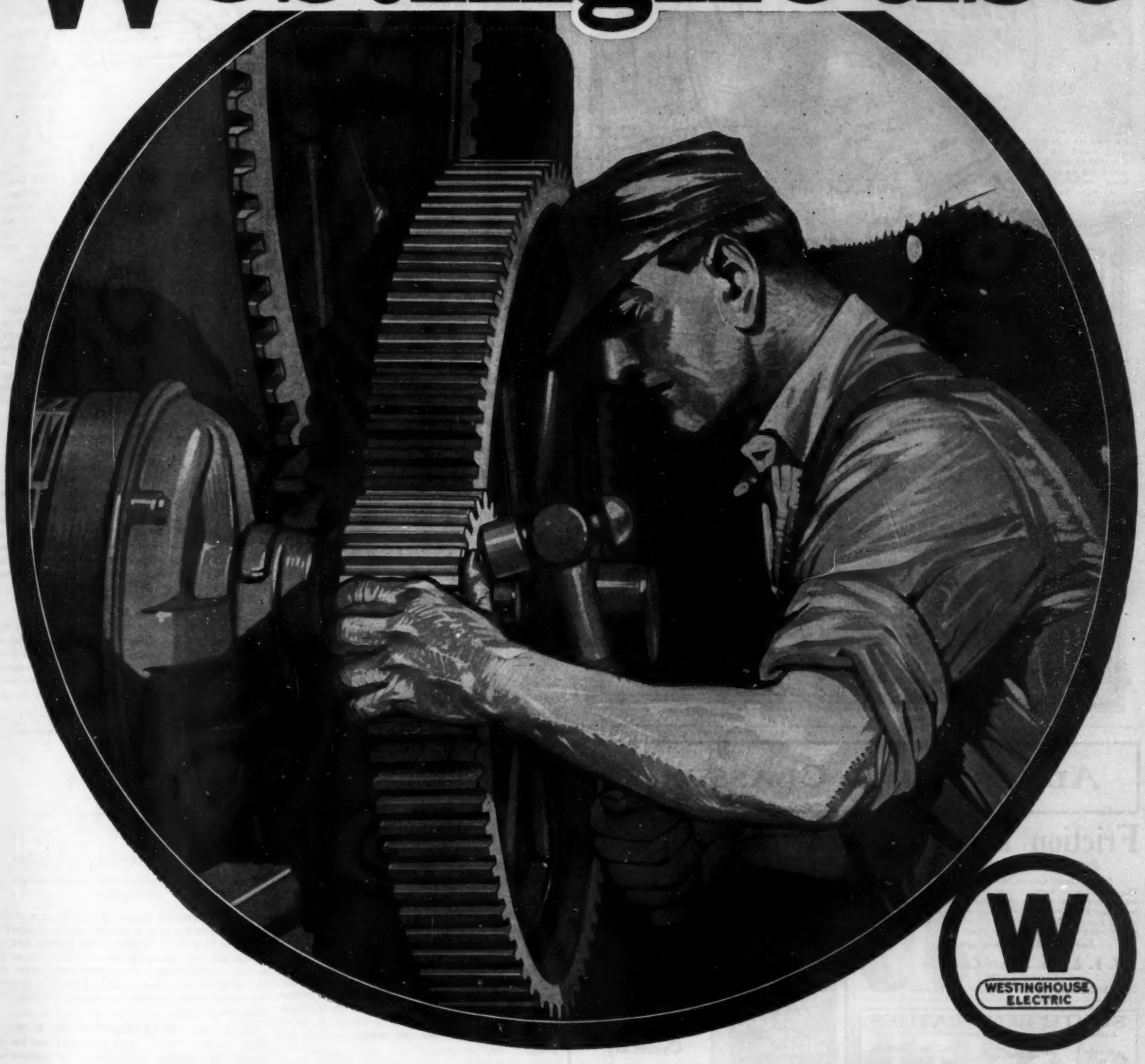
Heating and Lighting

DEVICE FOR CONTROLLING SUPPLY OF WATER TO BOILERS.—B. F. WOOD, Goose Creek, Texas. The invention provides for automatically regulating the supply of water to a boiler; it comprises in combination with a boiler and the valve for controlling the flow of water thereto, a tank having communication with the boiler above and below the water level of the same, a slide rigidly secured to and depending from the tank, guides on the boiler for the slide to permit the slide to move vertically, a lever connected intermediate its end to the valve for operating the same, and adjustable connection between one end of the lever and the tank for moving the lever when the tank moves vertically and a counterpoise connected with the other end.

GRATE.—J. S. WASHBURN, Suffern, N. Y. The object of the invention is to provide a grate arranged to insure proper burning of the fuel especially coal and to permit of readily disposing of clinkers, lumps, and other similar matter. In order to accomplish this result use is made of fixed grate bars, a movable grate bar intermediate the fixed bars, the bars being provided at their outer faces with projecting grinding members, and manually controlled means imparting reciprocating movement to the movable grate bar lengthwise.

(Continued on page 260)

Westinghouse



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RECENTLY PATENTED INVENTIONS

(*Continued from page 258*)

Machines and Mechanical Devices

CHANGE MAKING MACHINE.—J. R. COMBS, 420 W. 116th St., New York, N. Y. The invention relates to change making machines wherein the amount of money tendered, the amount of the purchase, and the amount of change due, are indicated, and which delivers the exact change in the fewest denominational units. One of the main objects is to provide means for the delivery of the monetary notes, as well as coins, at a common delivery point, instead of only coins as in some machines of this class. A further object is to provide means for segregating notes in each of a plurality of stacks of different denomination, whereby the possibility of delivering more than a required number of notes from a stack is prevented.

SALARY COMPUTER.—J. P. COMBS, 420 W. 116th St., New York, N. Y. Among the objects of this invention is to provide a machine whereby individual monetary amounts may be accurately and instantly made up in the fewest denominational units, as for varying wages of a force of employees. Further objects are to provide a machine wherein the zero keys of the several banks are normally in depressed position as a means of safety, to provide a machine in which a free keyboard is employed to return all keys to normal positions after a calculation, to provide a machine wherein mistakes may be readily rectified at any time before the completion of an operation, and to provide a machine in a compact and foolproof form, and of few parts not likely to get out of order.

FLUID SEAL FOR STUFFING BOXES.—C. L. ZINSSMEISTER, 86 Fourth Ave., Newark, N. J. The invention has reference more particularly to gas traps for autoclaves. An object is to provide a simple trap for gases of low viscosity and injurious to the standard packings used in connection with autoclaves. Another object is to provide an autoclave packing equipped with means for receiving a fluid of high viscosity which intercepts the flow of the injurious gases to the normal packing and thereby prevents injury thereto and reduces the leakage through the solid packing.

DISH FORMING MACHINE.—P. R. SIMMONS, Huntington, Ind. The invention relates to machines for forming paper dishes, pie plates, and the like, it more particularly relates to means for forming the dishes or plates by first cutting a roll of paper into shapes ready to be pressed and then feeding the cut paper to the forming machine to be subjected to the action of dies. The invention is particularly intended as an improvement on patents No. 1,044,931 and No. 1,147,759 granted to the same inventor; An object is to provide means for operating the first patent in unison with the second patent.

CONDENSER FOR DISTILLING PLANT.—W. A. DUFFY, 112 Cumberland St., Brooklyn, N. Y. This invention has reference more particularly to condensers for plants suitable for distilling salt water. An object is to provide a condenser having a series of removable flasks connected in parallel through which the cooling medium is circulated, so that a flask can be easily removed or replaced, as the case may be, without materially affecting the distilling plant.

Medical Devices

HYPODERMIC NEEDLE.—R. H. RIETHMUELLER, 111 Hudson St., New York, N. Y. The invention relates to needles for effecting hypodermic injections as administered in the practice of medicine, dentistry, and veterinary surgery. The object is to prevent the needle accidentally breaking within the tissues, by providing means to limit the extent of thrust of the needle, such means being in the form of a flange or collar adjustable to any selected distance from the point.

DENTAL PROCESS.—H. W. BABCOCK, Onarga, Ill. The invention has for its object to provide a simple, inexpensive and easy method of crowning teeth by the so-called jacket crown, wherein the method may be carried out by the average dentist without special equipment. The device consists of an artificial porcelain crown having the cavity of a size to loosely receive the prepared portion of the tooth, and having arranged therein a matrix of pure gold, and fitting within the crown. These jackets may be carried by dentists and applied to any tooth by merely preparing the crown of the tooth, and placing the amalgam in the crown.

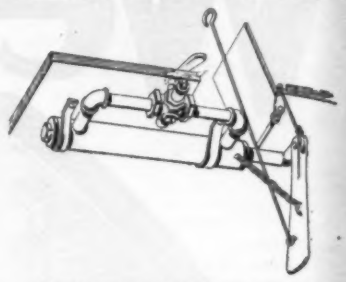
Prime Movers and Their Accessories

PISTON RING.—P. F. PROBASCO, Kansas City, Mo. This invention has for its object to provide a piston ring having interlocking portions formed with a diamond shaped head and a plurality of prongs at the end and a head recess with prong sockets at the other end, the head and prongs and the head recess being adapted to fit together when the ring is applied to the piston of an engine.

A PERSPECTIVE VIEW OF THE RING

Railways and Their Accessories

FLUID CONTROLLED SWITCH OPERATING MECHANISM.—J. B. STROUD, Pass Christian, Miss. The more particular purpose of this invention is to equip street railway cars with a mechanical switch thrower. A compressed air cylinder beneath the car floor operates a piston provided at its end with a jointed switch arm. The motorman from his place on the car operates a valve to cause the piston to position the switch arm for engaging the switch point as the car approaches the switch. In another position of the valve the piston is reversed to restore the switch arm.



A PERSPECTIVE VIEW FROM BELOW

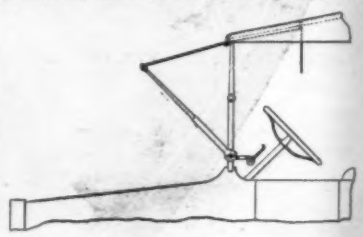
CAR MOVER.—C. M. CARTER, care of McCarter & Evans, Decator, Ill. An object of the invention is to provide an easily manipulated car mover which is characterized by a frame having rollers for engaging the car rails, with means on the top of the frame for engaging the sides of a car wheel to increase the stability of the mover, and to increase leverage by compounding same, the levers being disposed obliquely to increase the stability of the mover and facilitate the manipulation of coupled cars.

Pertaining to Recreation

TOY HOOP.—T. ENOMOTO, 162 Main St., Watsonville, Cal. The invention relates to toy hoops adapted to be trundled by trundling stick to engage and propel the hoop. An object is to provide a hoop made of a single strip of the outer skin of bamboo, the strip being wrapped spirally about itself throughout the hoop into a plurality of layers, with the respective layers so arranged that the ends of the strip are securely clamped between the layers and a desirable total effective width is given to the hoop.

Pertaining to Vehicles

AUTOMOBILE STORM AWNING.—G. H. HUNT, Monroe Center, Ill. The invention relates to awnings to be used in connection with the top of an automobile to protect the upper part of the wind shield from rain, snow or sleet so that the vision of the driver will not be obscured, and also for shutting out the rays of the sun or elevated street lights. A more specific object is to provide a waterproof flexible awning which can be operated from within the automobile, there being spring-actuated arms on the sides of the wind shield to forwardly project the awning, and locking means for holding the supporting arms.



SHOWING THE INVENTION APPLIED TO AN AUTOMOBILE

TRACTOR ATTACHMENT.—E. E. WILHITE, Algona, Iowa. The invention has for its object to provide mechanism in connection with a truck of any character for permitting the rear wheels, their connections and the rear end of the frame to be detached from the forward end, and to be replaced by the rear wheels and their mountings of a tractor.

AUTOMOBILE REST.—J. A. BEIERSCHMITT, Fairbank, Ohio. The invention relates to a rest or jack whereby an automobile may be lifted by its own power when in the garage to relieve the tires from the weight of the machine, more particularly the invention relates to a rest involving the use of a platform adapted to have limited travel on front and rear track rails when the automobile is run over the platform and the front axle thereof engaged with the platform.

TRACTOR.—J. E. LONG, 411 Cook Ave., Portland, Ore. The invention relates generally to tractors, and more especially to agricultural tractors, the object being to provide a simple inexpensive type of tractor capable of ready control, and having a special arrangement for changing the speed or direction of the engine to permit of development of the most power to the driving wheel when the tractor is going slowly, and vice versa, in order that when the load is heaviest, the tractor will proceed slowly, and when light, may be made to correspondingly increase its speed by simply shifting the friction wheels respectively from and towards a friction disk.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Current Supplement

ELECTRICITY is such a universal factor of our daily life and of the activities of the world that it is impossible for any single individual to follow all of its developments; but some general ideas of the progress that is being made are desirable, and the paper on *The Electrical Industry in America* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2230 for September 28th, will be found particularly helpful, as it is a discussion of phases of the industry of special present significance by one of the leading experts of the country, and it also contains some valuable forecasts of the future of the industry. *War Service Schools in Educational Institutions* notes some of the valuable work now being done by our educators, and is illustrated by a number of photographs showing how one of our best technical schools is helping in a practical way. The article on *Thermostats* reviews various types of instruments for measuring and recording temperature in technical operations, and methods and conditions of their application. *Making and Destroying Paper Money* tells how the U. S. Bureau of Engraving and Printing and the Redemption Division work, and is accompanied by a large number of excellent illustrations. *Liquid Films* treats of an interesting physical problem studied by means of soap bubbles. *Notes on the Testing of Magneto Magnets* discusses a subject that presents many difficulties, and describes and illustrates an ingenious instrument devised for the purpose. *A Review of Mycology* deals with important questions of biology that demand much further study, and considers at some length two of these, Cytology and Symbiosis. Other articles of interest include *The Southern Cross, A Steel Ship Built Without Rivets, War Coins of the Central Powers* and *A Serious Wheat Disease.*

Woods For Making Airplanes

(*Continued from page 249*)

the boards used in the laminations are parallel to the medullary rays, the propeller is likely to warp, due to the unequal radial and tangential shrinkage. In mahogany, on the contrary, the shrinkage is practically the same in both planes, thus making special sawing unnecessary. Red oak is excluded because, in general it is a poorer, coarser wood than white oak. Selected specimens of it may be as good as the white, but the danger of getting poor stock is too great to justify its use.

Black walnut makes a good propeller, but the demand for this wood for gunstocks takes precedence over its use for other purposes. Considerable black walnut veneers are used in some of the plywood panels. The thinnest veneers of all can be cut from mahogany; three-ply material of remarkable toughness and strength is now being produced which is only about one-fiftieth of an inch in thickness. Such material is used to cover portions of the fuselage and may replace fabric in certain other parts. For the heavier ply-wood birch is extensively employed, with a core of yellow poplar.

The airplane is undergoing many changes in design and construction, but there is little indication at present that wood will be replaced by other materials. There is a tendency to use solid wood and more laminated material or ply-wood. In this way many of the natural limitations and uncertainties of the natural product can be overcome and a long stride made toward the standardization of a variable material. And with such construction will come a complete reappraisal of wood values and a consequent increase in the number of kinds which will meet the new requirements.

Strategic Moves of the War

(*Continued from page 250*)

supplies, has been taken. It is also claimed that the line of the Trans-Siberian throughout its length from Vladivostok to the Volga River in Russia has also been cleared. But the greatest success can be gained only by Allied troops in force being moved to the present eastern front on the Volga in Russia, where German influence and military power can be combatted with effect. The Allied forces that control Archangel and Kola, the two railroad terminals from the Arctic Ocean to the centers in the interior of Russia, effectually blocked the Arctic coast from German troops in Finland and threaten any army that Germany may try to recruit there. The main question now is as to the strength of the forces needed to crush the fast waning power of the Germans and Bolsheviki in Russia proper.

A very successful French-Serbian offensive on the Salonica front between Monastir and Lake Dorian of the east is reported, resulting in the capture of many prisoners and guns. A campaign inaugurated here at this time would no doubt give good results since there are few Austrians or Germans left on the front and Bulgaria is discouraged and on bad terms with Turkey over the division of the territorial spoils resulting from past campaigns. However, the main significance at this time is the proof that it gives of Allied confidence and strength and the converse as regards the Central Powers. It may take some time to gain obvious advantages that will influence the campaigns on the western front; but, if once Bulgaria can be defeated, and detached from the Central Alliance, if the Austrian flank can be exposed, and if the weakness of the Austrian military system can be shown, it will ultimately result in diminishing Germany's strength on the western front. German man power is on the decline and needs Austrian help in the west, all of which means that Bulgaria and Austria can expect no assistance in their struggles in the Balkans. The new offensive here may be of advantage to the Allies because progress can no doubt easily be made; and victory here will quickly react on the operations on the western front.

How Holland Will Dispose of the Zudyer Zee

(*Continued from page 251*)

No. 3 will be started in the twenty-first year and made ready in the twenty-eighth; and Polder No. 4, contiguous to Friesland, will be begun in the twenty-fifth year and drained and offered to agriculturists in the thirty-third year. In this way, the national authorities count upon obtaining revenue from the undertaking in the fifteenth year.

The engineers who have examined the bed of the Zuyder Zee are confident that quite 90 per cent of the bottom is covered with silt and cultivable clay, which means that the arable area of the country will be augmented by nearly 480,000 acres in the four polders. It is further figured that the drained region will accommodate an industrial population of about a quarter of a million. The body of water remaining will have an area of 560 square miles, and being made up entirely of the ebb of the inflowing rivers the water will be fresh. This change will be an economic blessing, because fresh water is difficult to get in some of the regions now contiguous to the Zuyder Zee, and the altered condition will promote farming and cattle raising in sections where these are now out of the question.

The average depth of the Zuyder Zee is 12.3 feet in those parts where the polders will be formed, and for this reason the building of the confining dikes will not present any notable engineering problems. Yssel Lake, which will supplant the Zuyder Zee, will be so restricted in its extent and modified in form that storms will not lash it to destructive fury. As a result, the Hollanders will be saved annually great sums of money and much labor which are now spent in preserving the existing Zuyder Zee dikes against erosion and failure. Finally, the channels in Yssel Lake will be more permanent and it will be comparatively easy to maintain depths sufficient to accommodate larger vessels than those now traversing the Zuyder Zee's treacherous waters.

As matters stand now, rail movement from parts of Friesland to Amsterdam and other commercial centers close to the North Sea coast is very much hampered by reason of the circuitous route that has to be followed in skirting the Zuyder Zee. Many miles of travel will be eliminated when the shorter rail run across the sea dike becomes available. The total cost of the undertaking will call for an expenditure of substantially $90,000,000. This will include an indemnity for the fishermen who now make their livelihood in the Zuyder Zee and which they can no longer do when the fresh water of Yssel Lake will cause certain kinds of fish to disappear. It is also proposed to move the fishing villages, which will be absorbed in the building of the polders, to points on the North Sea coast where the industry will be established anew.

The Construction Division of the United States Army

(*Continued from page 253*)

talent of one of our most conspicuous and most beloved industries, building, is performing a miracle.

One must know these men to catch the spirit and enthusiasm of it all. Nothing like it was ever done—men who are leaders, star players if you will, working night and day planning and studying their problems and often solving them in the wee hours of the night, able and efficient in everything they do. Ably led by the only regular army officer in the whole division, they are keen in the constant improvement of their great supervisional machine. As an administrative organization they are modestly and quietly carrying on this great work with no other thought of reward than that their work shall serve its purpose and build with lightning rapidity and at the minimum expense the structures without which there can be no army, and only a lame preparation for the continuation of the war to its successful conclusion.

Prince Albert is a peach of a pal!

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QUICK as a flash Prince Albert plugs the hungry-hole in your smokeappetite—and—sets you busy-busy a'puffing-in the joy'us flavor and smiling like it's sunny-spring far and near—and twilight lasts all night! You're "on-your-own" then, sure-thing! And, in for a swell right-handed-blowout that'll speed your smoke-motor to new high-top marks!

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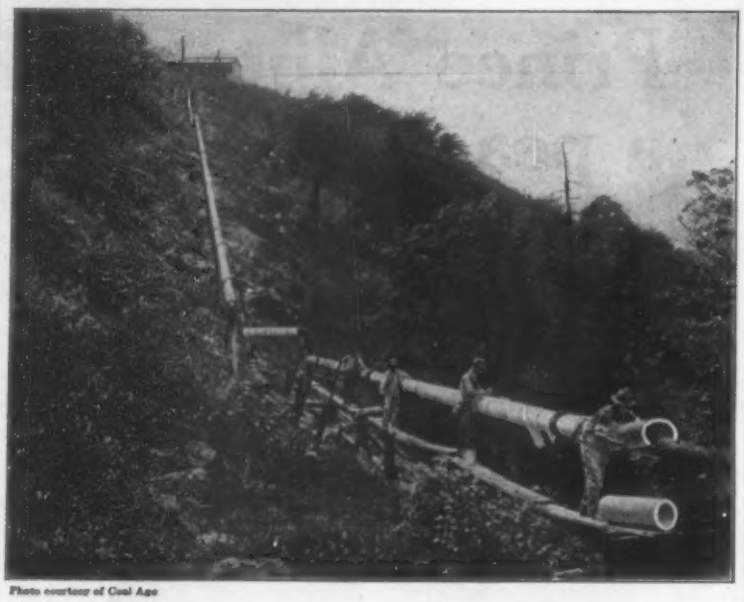

Photo courtesy of Coal Age

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Finding Bullets with the X-Ray

(Continued from page 255)

tests corroborated the first findings and it was possible to measure the depth of the bullet, in both directions, from the posterior-anterior, two and a half inches, and lateral, three and a half inches. These findings were marked and through an incision made over the posterior mark on the buttock, I was able immediately to put my finger on the bullet in the spot designated by the localizer. The measurements were taken and corresponded absolutely with those given by the localizer.

"The localizer is simple in its operation, and foreign bodies are rapidly located. I do not hesitate to state that it does not require an expert to use it. Dr. Friedrichs was present at these tests and I am sure he will substantiate my statement that after witnessing a few demonstrations any intelligent person could use it. I repeatedly timed Dr. Granger, who was able, with the localizer in place under the patient, to locate the bullet in one-half minute."

Potash from the Lavas of Vesuvius

HENRY S. WASHINGTON, of the Physical Laboratory of the Carnegie Institution, Washington, has published an interesting paper on potash obtainable from certain volcanic lavas. According to him, the igneous rocks of the earth's crust contain, on an average, about three per cent of potash (K_2O), some of them running as high as over ten per cent. It is upon these, and especially those richest in potash, such as the leucitic lavas of the Italian volcanoes, that the world will ultimately have to depend in great part for its supply.

The minerals which are especially important for their content in the Italian rocks are two in number, both silicates of potash and alumina, but with different ratios of silica to the other two oxides. The more important of the two, because it is the richer in potash and the more abundant in these lavas, is leucite. Although met with in volcanic lavas in various localities in different parts of the world, leucite is rather a rare mineral, except along the line of the Italian volcano, where it may be said to be characteristic of the lavas. Theoretically leucite contains 21.5 per cent of potash (K_2O) with 23.5 of alumina (AL_2O_3) and 55 per cent of silica (SiO_2) but analyses show that the natural crystals actually contain about 19.5 of potash, the reduced percentage being due to the presence of small amounts of soda and other impurities.

The other minerals, orthoclase (potash feldspar) are much less abundant and of less importance than leucite in most of the Italian leucitic lavas. Elsewhere, throughout the world, it is much the more abundant and important of the two.

Vesuvius is the only active volcano of the Italian series. On the whole, its lavas are very uniform and are all leucitic. Their average potash content is between 7.50 and 8.00 per cent, but in the lavas of some of the now extinct volcanoes the percentage is nine. The following table shows the total amount of potash content in all the volcanoes of the series:

Volcano	Leucitic lavas Metric Tons	Potash Per cent (K_2O)	Amount of Potash Metric Tons
Bolsena	33,600,000,000	8	2,688,000,000
Vico	18,540,000,000	9	1,668,600,000
Bracciano	10,360,000,000	9	932,400,000
Alban Hills	23,240,000,000	8	1,859,200,000
Rocca Monfina	11,200,000,000	9	1,008,000,000
Vesuvius	8,400,000,000	7.5	630,000,000
Total	105,340,000,000		8,786,200,000

In considering these figures it must be borne in mind that in nearly, if not quite, all respects they are thought to be rather under- than over-estimated, and it would, therefore, be reasonable to suppose that the row of Italian volcanoes contain at least some 10,000,000,000, tons of potash. It may be of interest to note that German industrial societies had in recent years, before the war, been active in researches in the Italian leucitic lavas for the manufacture of "chemical products."

French Use of X-Rays on Metals

THE use of X-rays for examining the structure of metals and alloys, installations for which purpose have been erected in some of the largest engineering works in France, is one of the late interesting metallurgical developments.

It is a generally accepted maxim that metals are opaque to the X-rays, but since the introduction of the new tube of Dr. Coolidge, which is similar in principle to the wireless thermo-valve, an entirely new order of things has arisen. The discharge from an X-ray tube can be enormously increased by making the cathode of a spiral of tungsten, to focus the cathode stream. The tungsten spiral is heated by means of a local battery, causing it to give off a stream of negatively charged electrons. This enables an intensely powerful beam of X-rays to be generated, with the further very great advantage that the intensity can be controlled or regulated by the degree of heating of the tungsten spiral. The vacuum of the Coolidge tube is 1,000

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times greater than that of the ordinary tube.

Rays can be generated in this tube capable of penetrating four inches of hard steel, and a flaw in the steel of as small diameter as one-sixty-fourth of an inch can be photographed. An important new means of examining alloys and castings has thus been found, and a considerable amount of research is being conducted with the object of developing it on commercially useful lines. The method has been found very useful in examining aluminium weldings, and also in testing small air holes in the castings of new alloys.

The installation consists of a powerful induction coil, or a high-tension transformer capable of applying to the terminals of the tube a pressure up to about 250,000 volts. At this high pressure the current passing through the tube is between one and three milliamperes. One result of the work has been to establish the fact that the penetrating power of the X-rays depends solely upon the potential applied to the tube.

The most stringent precautions have to be observed to protect the operator from X-ray "burns." All ordinary protective media are useless. The tube is enclosed, except for the aperture through which the X-ray beam passes, in a box heavily lined with lead, and the operator usually manipulates the apparatus from a cabinet, also heavily lead coated, placed in another room. The exposure may be from one to four, or even five, minutes; as the anode of the tube quickly gets red-hot, it may be necessary to give a part of the exposure, allow the tube to rest, and then continue the exposure. Water-cooling devices are in use for cooling the anode. The discharges are many hundred times greater than those usually employed in medical work.

The method of examination is purely photographic. In medical work, a great deal is done by visual examination with a fluorescent screen; but in dealing with castings two or three inches thick the degree of visibility of a flaw is too small to make visual examination possible. A photographic plate is therefore exposed underneath the metal, but the exposure ordinarily necessary can be reduced by 95 or 96 per cent by means of a new "intensifier screen" made specially for radio-metallographic work and placed in contact with the plate. Such is the discriminating power of X-rays of even this enormous degree of penetration that while a hole — of an inch in depth can be clearly detected in a two-inch hard-steel casting, the delicate structure of a scarab can be discerned with completeness. The entire structure of a fuse in a shell, the internal parts of a sparking plug, and so on, can be photographed with the precision of a draughtman's drawing; and differences in thickness of — of an inch in mica insulators can be detected. As regards rapidity of working, which is important from a commercial standpoint, 60 radiographs have been made in ten minutes in a test carried out for routine testing. The great advantage presented by the Coolidge tube is that the working conditions can always be kept constant, and any given conditions can be exactly repeated on a future occasion.

Wartime Lighting in Denmark

THE lighting problem in Denmark has assumed such proportions that the Danish government recently purchased 400 tons of tallow from which to make candles. There is a scarcity of kerosene, also, and electricity is, of course, not available to the isolated farmhouse. Considerable discussion of and numerous suggested solutions for the lighting problem have appeared in the Danish press of late, the *Tidsskrift for Industri* having recently said in regard to acetylene and alcohol lamps:

Normally the main sources of light in Denmark are electricity, gas and petroleum, the first and last probably being the most important. The first two forms of light are decided by the supply of coal, which at present is scarce (and the Diesel motor plants are to a great extent replaced by steam plants), while petroleum is hardly to be had. As petroleum lamps in many homes, especially in the country, are the main source of light, it has been necessary to look for substitutes.

The stores of petroleum have been closely rationed, and great economy has been a necessity with those households that have been accorded only two or three bottles of petroleum per month. Petroleum-saving lamps have been brought on the market—these contrivances, giving only one-third candlepower, can be called "lamps." The best known of these new lamps consists of a thin stem or pipe, with a wick and a small reservoir for oil. The wick is of cotton, and in order to make it resist the flame the top of it is of asbestos. The amount of petroleum consumed by these lamps is very small—as is the light given.

Many ways and means of supplying light have been thought of and tried, but the two most important are acetylene and alcohol illumination. The acetylene lamp is the better of these. Acetylene gas, however, is explosive, and in order to guard against this danger the Minister of Justice appointed a committee to examine the more commonly used lamps. None was found to be satisfactory. The committee then suggested that acetylene be used in cases of need, and that the lamps used heretofore be first examined and approved by the Ministry. The most common types of lamps thereafter used were the drop system, where the water drips on the carbide, and the system where a reservoir with carbide is sunk into water, which thus rises in the reservoir.

The Ministry has also passed some special regulations with regard to the use of acetylene gas in signal lanterns, where it was highly necessary to find a substitute for petroleum, the shortage having made it impossible since December 1st last to deliver any petroleum for this purpose. This was an especially difficult question, the international rules with regard to these lights being very particular as to candlepower, burning time, etc. The Marine Ministry, therefore, appointed a committee of experts to find the best type of lamp for this purpose, with the result that the Ministry since November last has permitted acetylene lighting in signal lamps, under certain conditions. More than 100 ships—mainly large ones—have been supplied with these lanterns, and this has been a great aid to the highly important shipping trade.

Acetylene may now legally be used, and may be included in fire-insurance risks. As a result, the manufacture of acetylene lamps has flourished greatly, and at the end of the year no less than 180 types had been put on the market at prices from 5.50 to 30 crowns ($1.50 to $8.00 at normal exchange).

The main objection against acetylene lamps is that many lamps, because of cheapness of construction, become so warm when they have been used a short time that the lighting power of the gas is reduced by the steam formed. Only large lamps can give 20-candlepower a whole evening without having to be refilled, and these are not cheap. Even the best lamps require very careful attention.

Under present conditions alcohol is the natural successor of petroleum for lighting. Realizing this, a company was formed last October and it has been successful in inventing a lamp which is very economical in use. The lamp is incandescent and burns in much the same manner as the incandescent gas light. While the petroleum-saving lamp referred to is excellent for use in places where only a dim light is necessary, the alcohol lamp is the ideal house lamp, with prices of petroleum at their present high level. Lamps giving 30 candlepower are all that is necessary, and are very economical; and, furthermore, alcohol is a Danish product, and may be made from cheap materials.

Automatic Hydroelectric Plant

A HYDROELECTRIC generating station which is entirely automatic in all of its operations has recently been placed in service on the Cedar River, only a few blocks from the business district of Cedar Rapids, Ia. The plant, which will have an ultimate capacity of 2,000 kw., operates in parallel with an extensive transmission system which already reaches practically across the State, except for a 28-mile break near Marshalltown. There are no instruments in the hydroelectric plant, these being installed in the company's steam station, which is about 0.6 mile distant. Three groups of conductors—power cables, instrument cables, and control cables—connect the two plants; hence, while the hydroelectric station is self-controlled and entirely automatic, it is possible for the steam-plant operators to supervise the action of the waterwheels and generators.

Perhaps the most spectacular and surprising feature of the whole plant is the speed with which the station goes into service. It requires just 37 seconds from the time the first switch operates until the first generator is under full load. A somewhat formidable array of mechanism might be expected in a plant of this nature, but the contactors and switches are inclosed in cabinets and the buses and control wires are run through bus chambers beneath the floor, so that the interior of the station appears very simple. With this arrangement, and by making each generator and its circuits, except for excitation, an independent unit, every element of the wiring and control apparatus has been made readily accessible.

The excitation for each machine is maintained at a fixed value at all times, thus simplifying the excitation problem, eliminating the necessity of voltage regulators, making it possible to take advantage of the full capacity of the river, and at the same time improving the power factor of the system through the operation of underloaded, overexcited machines. No oil governors are used for any of the machines, the gates being operated by motors which are upon complete automatical control at the hydroelectric station or remotely controlled from the steam station.

Balzac—greatest of French fictionists—used to keep seven quill-wielders busy at one time. They wrote to his dictation in longhand. ❦ ❦ ❦ But the typewriter changed all that. It increased *tremendously* the power of the copyist. ❦ ❦ ❦ And just as the typewriter revolutionized old methods, so, in turn, does the *Mimeograph* multiply the power of the typewriter. It reproduces five thousand perfect duplicates of a typed or written sheet an hour—*at small cost.* And designs, sketches, plans, signatures, etc., may go on the same sheet, in the one operation. *Unexcelled* is the work of the Mimeograph now—and *needed.* Get booklet "A4" from local dealer, or A. B. Dick Company, Chicago—and New York.

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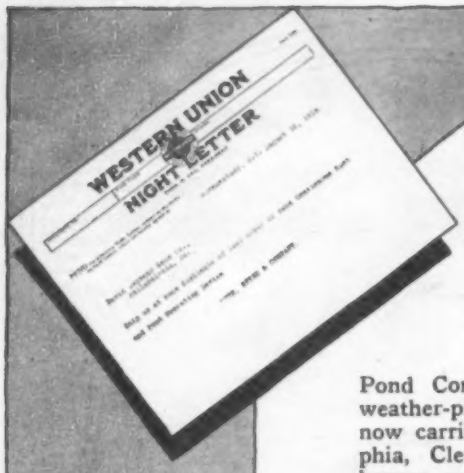

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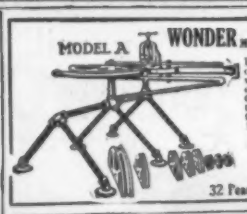
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NEW BOOKS, ETC.

OVER THE THRESHOLD OF WAR. Personal Experiences of the Great European Conflict. By Nevil Monroe Hopkins, Major, Ordnance, Officers' Reserve Corps United States Army. 8vo.; 375 pp.; 70 illustrations. Price, $5 net.

During the first months of the war Major Hopkins, hitherto known as a writer of ingenious mystery stories, found opportunities for first-hand observations in Berlin, Russia, France and England. In this beautiful product of the publisher's art we are plunged into the feverish activities of those early days, and see how the peoples of the affected countries reacted to the stirring succession of events. Two reasons may be advanced for the charm of the work; the first is that, as a writer of popular fiction, the author could hardly fail to cast his experiences into readable literature; the second cause for the vitality of the work is that it is elaborated from a diary, and hence produces the effect of actual presence, in time and place, at the happenings recorded. The reader simply accompanies the writer in his travels, meets representative men of affairs in the various countries, and listens to the chatter of the street. National prejudices, attitudes, and psychology are thus revealed, and the effect is heightened by artistic sketches and by the reproductions of photographs from the camera of the author.

THE AMERICAN SPIRIT. Addresses in War-Time. By Franklin K. Lane, Secretary of the Interior. New York: Frederick A. Stokes Company, 1918. 12mo.; 142 pp. Price 75 cents net.

The Secretary of the Interior brings together in this book some of his most spirited and educative utterances; all are couched in the language of democracy and unselfishness, and are true to the best American ideals. Democracy, the author insists, means more than universal suffrage or self-government; it is an attitude toward mankind and its problems; in short, a philosophy of life; it is a sane individualism opposed to that ancient doctrine of divine right that inevitably degenerates into something that is neither divine nor right. He speaks of the unconquerable soul of America, of our sturdy pioneers, the rights of neighbors, American tradition, our reasons for fighting Germany, and the importance of foresight and cooperation. Always there is the vision brought out in the address, "A New and Greater America," and the collection may be heartily commended to every loyal citizen of the land.

CELLULOSE. An Outline of the Chemistry of the Structural Elements of Plants with Reference to their Natural History and Industrial Uses. By Cross and Bevan. New York and London: Longmans, Green and Co., 1918. 8vo.; 366 pp.; illustrated. Price, $4.50 net.

This new edition of an impressive work measures more recent development along scientific, technical and industrial lines by landmarks in the field of organic chemistry. It describes and studies "illustrative types of necessarily 'natural' substances," classified on the basis of ascertained chemical variations, and of derivatives resulting from well-known processes of synthetic addition, or of more or less destructive resolutions, chiefly by processes of hydrolysis and oxidation. The maintenance of the scientific perspective has been deemed of more importance than the practical details of processes. The appendices carry some good plates from microphotographs and give a brief outline of the main paths of growth in our knowledge of the subject.

A DICTIONARY OF MILITARY TERMS. By Edward S. Farrow, Late Assistant Instructor of Tactics, at the United States Military Academy. West Point, New York. New York: Thomas Y. Crowell Company, 1918. 12mo., 694 pp.; illustrated. Price, $2.50 net.

This pocket size lexicon, printed on Bible paper and defining 12,000 military terms, may be put to good use not only by army men and writers on military affairs, but also by the general reader, who meets in the literature of the day so many words and phrases that the ordinary dictionary ignores. The work covers arms and equipment of all kinds, aeronautic terminology, French phrases, and even the jargon of the trenches: it also pictures and describes the distinguishing marks of the Army and Navy.

GAGES AND GAGING SYSTEMS. Design, Construction and Use of Tools, Methods and Processes Involved. By Joseph V. Woodworth. New York: Hill Publishing Company, 1908. 8vo.; 258 pp.; illustrated.

The increased output and efficiency of duplicate machinery is very largely due to the perfection of methods in the making of precision tools and interchangeable parts. This work deals with the various gages, indicators and test tools in a clear and comprehensive manner, showing construction and explaining their use in the working of metal parts and the reducing of surfaces to accurate dimensions.

THE MENTOR. April 1st, May 15th, July 1st. New York: The Mentor Association, 1918. Price per copy, 20 cents.

The April 1st issue of *The Mentor* introduces us to Rodin and his art. Villemin has handled his subject so enthusiastically and so well that before he has finished we agree with him that Rodin was not only a great sculptor but also a great intellectual force. The splendid loose-leaf plates show some of his most striking marbles. The May 15th number is devoted to Benjamin Franklin, and the number of July 1st to the Cradle of Liberty. As a picturesque subject for study, Franklin possesses innumerable attractions; his wise and pungent sayings are as sound today as when uttered, and his life contained dramatic episodes that Professor Hart has not been slow to avail himself of. . . . The Cradle of Liberty! Little more than a year ago there were some among us who thought that Liberty had gone to sleep in her cradle; but she awoke and since then has accomplished miracles. It is good to go back to the days of her birth, to stand with the Minute Men, to ride with Paul Revere, and to relearn the truth that liberty means "a political religion, a worship, an inspiration."

PRINCIPLES OF CHEMISTRY. By Joel H. Hildebrand, Ph.D., Captain, Ord. O. R. C. New York: The Macmillan Company, 1918. 8vo.; 323 pp.; illustrated. Price, $1.75.

The average textbook in chemistry assumes that its order and arrangement will be strictly followed; if it is not, much of its value to the student is lost; if it it is, freedom and individuality are threatened. The author of this new text has admirably avoided much of this difficulty by an arrangement of material that conduces to the utmost flexibility; his subject divisions may be used with various forms of descriptive material, and provision has been made for considerable departure from the given order.

AUTOMOTIVE WIRING MANUAL. By Harry L. Wells, in collaboration with Allan J. Pierson and Datus M. Pierson. Chicago: Automotive Publishing Company, 1918. 4to.; 616 blueprint diagrams.

This Manual, aside from a few concise pages of descriptive material, consists of a collection of diagrams dealing with motor car wiring circuits and covering practically all makes of car from 1912 to 1918. It enables the student easily to trace electrical circuits and to place and remedy any difficulty that may arise, and the mechanic will recognize in it an aid that will render him capable of furnishing prompt and efficient electrical service to his patrons.

THE KOEHLER METHOD OF PHYSICAL DRILL. By Captain William H. Wilbur, Infantry, U. S. Army. Philadelphia and London: J. B. Lippincott Company, 1918. 16mo.; 149 pp.; illustrated. Price, $1 net.

The success of the West Point physical drill under Major Koehler's wise instruction is unquestionable. As assistant under Major Koehler Captain Wilbur has had every opportunity of gaging the possibilities and benefits of the system, and his presentation of the subject raises it out of the drudgery that a drill of this kind is apt to become when followed by the lone individual at his own home, or even in class under what is too often lukewarm leadership. Questions are answered, and difficulties squarely met, by Captain Wilbur, while the poses of Cadet Stenzel as reproduced in pictures make the various exercises readily intelligible.

GUIDE TO THE USE OF UNITED STATES GOVERNMENT PUBLICATIONS. By Edith E. Clarke, Chief of Cataloging, Office of Superintendent of Documents, 1896-1898. Boston: The Boston Book Co., 1918. 8vo.; 308 pp. Price, $2.50 net.

Our Government Printing Office, the largest "publishing house" in the world, keeps the government officials in touch with the work of yesterday and today and the plans for tomorrow; then there are noteworthy books on commerce and industry, science and sociology. The author has kept in view the needs of library training schools, and of the public library. She urges that government publications should not be grouped by themselves in the library with special codes of cataloging rules and separate classification systems, but should be handled precisely the same as other works.

OPTICS FOR PHOTOGRAPHERS. By Hans Harting, Ph.D. Translated by Frank R. Fraprie, S.M., F.R.P.S. Boston, American Photographic Publishing Co., 1918. 8vo.; 232 pp.; 57 illustrations. Price, $2.

HOW TO MAKE LANTERN SLIDES. Boston: American Photographic Publishing Co., 1918. 8vo.; 74 pp.; illustrated. Price, cloth, 75 cents; paper, 35 cents.

PRACTICAL EXPOSURE DISC. Boston: American Photographic Publishing Co. Price, $1.

A large part of the material of "Optics for Photographers" appeared serially in *American Photography* as translated by the editor of that journal; the papers have been brought together in book form, and tables in English measure have been included. The amateur or professional desirous of understanding the behavior of light, the process of image formation, the manner in which these phenomena govern lens construction, and the methods of determining focal length, relative aperture and distance relation, will find the exposition concise and understandable. "How To Make Lantern Slides" initiates the beginner into the essentials of good negatives, the simplest methods of slide making, and the formulas of developing and fixing baths that produce the best results for general work. The "Practical Exposure Disc" makes a satisfactory negative possible under any but the most unusual conditions.

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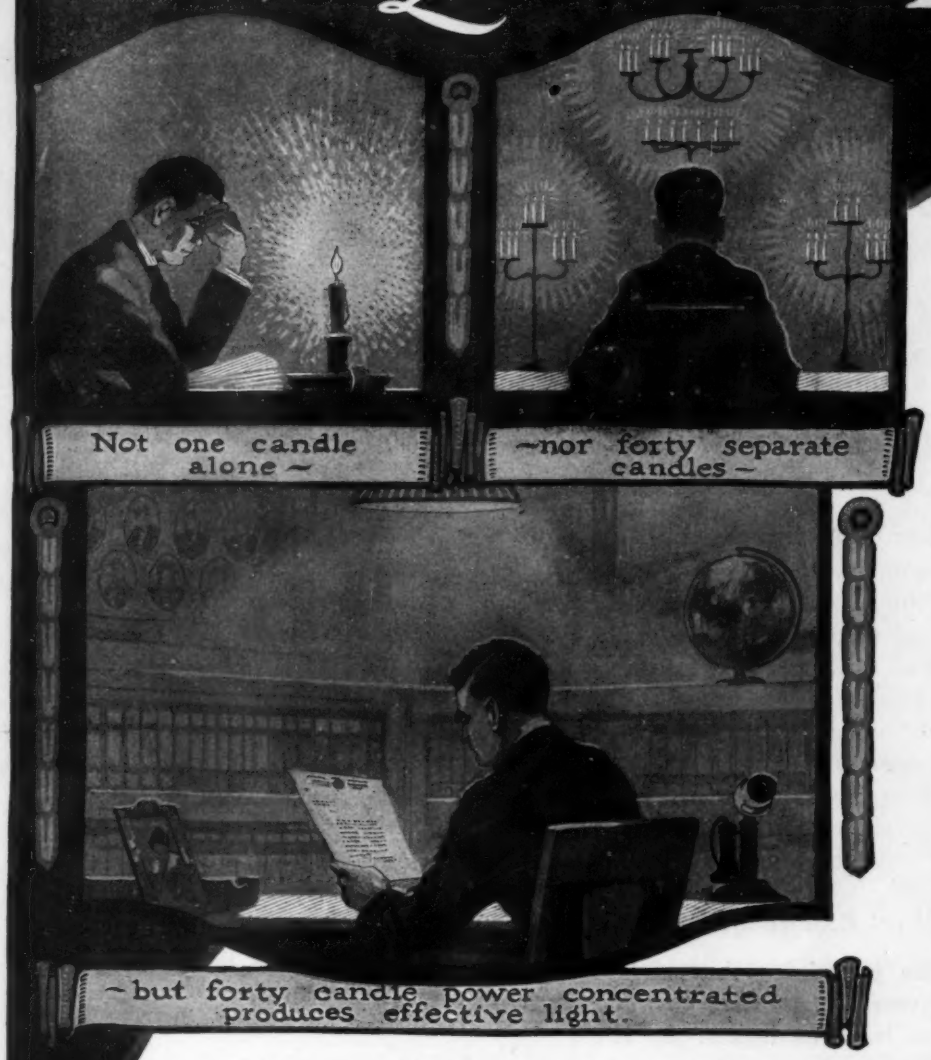

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